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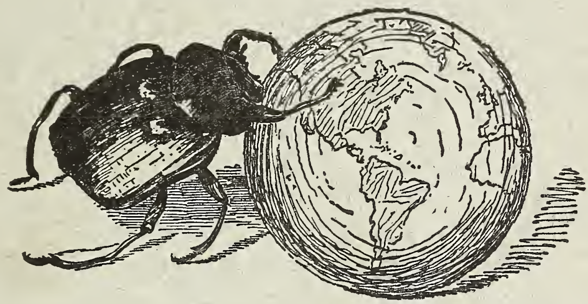

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Vol. XXXVII March, 1929 No. 1

THE GENERA AND SUBGENERA OF LEIODIDÆ AND CLAMBIDÆ[1]

By Melville H. Hatch

The preparation by the author of the portion on Leiodidæ and Clambidæ of the Junk-Schenkling *Coleopterorum Catalogus* made it desirable to establish a sequence for the genera of those families. The following key, compiled from the literature, is presented as exhibiting the basis of that sequence. A similar key to the species of *Colenis* Er. is appended at the end of the key to genera.

Leiodidæ

A¹. With eyes; tarsi three to five segmented; abdomen six (♂) or five segmented (♀).

B¹ Head without antennal groove beneath; tibiæ without longitudinal dorsal carina; anterior tarsi without spines; body usually not contractile .... **LEIODINI**

C¹. Metatarsi five segmented.

D¹. Antennal club five segmented.

E¹. Head short; clypeus small, feebly emarginate; pronotum transverse; tarsi 5–5–5; Holarctic, Oriental, Chili. **Hydnobius** Schm.

E². Head very prominent; clypeus distinct, deeply emarginate with four strong setæ; pronotum oval or oboval; Australia, Panama .... **Dietta** Sharp.

D². Antennal club three segmented.

E¹. Tibiæ slender, not strongly spinulate; Holarctic. **Triarthron** Märkel.

E². Tibiæ dilated, strongly spinulate; Madeira .... **Stereus** Woll.

[1] Contribution from the Zoölogical Laboratory of the University of Washington.

C[2]. Metatarsi with less than five segments.

D[1]. Tarsi 5–5–4.

E[1]. Antennal club five segmented.

F[1]. Pronotum not or feebly margined at base; protibia with moderately elongate spurs at apex, the outer edge with or without a tooth at extreme apex, not emarginate (*Anisotoma* Schm., Er., Lacord., Lec., Seidl., Horn, Leng, etc.—*Liodes* Reitt., Ganglb., etc.)......**Leiodes** Latr.

G[1]. Mesosternum not carinate; Nev., Cal. (type *L. ecarinata* Horn) ....subg. *Ecarinosphaerula* nov.

G[2]. Mesosternum feebly carinate, the carina terminating at the anterior margin of the mesosternum.

H[1]. Interstrial rows of punctures feeble; Holarctic, Cent. Amer. ....sub. *Leiodes* s. str.

H[2]. Interstrial rows of punctures as distinct as the strial rows; Europe..........subg. *Pseudohydnobius* Ganglb.

G[3]. Mesosternum strongly carinate; metasternum short.

[1]. Hind margin of pronotum feebly arcuate, its hind angles broadly rounded; wingless; Holarctic.
subg. *Oreosphaerula* Ganglb.

H[2]. Hind margin of pronotum more nearly straight.

I[1]. Outer apical angle of ♂ metatibia with a heel-like tooth; Europe..........subg. *Trichosphaerula* Fleisch.

I[2]. Outer apical angle of ♂ metatibia with a small tooth; all elytral striæ the same; Palearctic.
subg. *Oosphaerula* Ganglb.

F[2]. Pronotum completely margined at base; protibia with long spurs at apex, the outer edge strongly emarginate towards apex forming a lobe-like tooth at a distance of from one third to one half the distance from the apical end; Palaearctic ....**Chobautiella** Reitt.

E[2]. Antennal club four segmented; Nearctic, Cape of Good Hope.
Anogdus Lec.

E[3]. Antennal club three segmented.

F[1]. Elytra not transversely strigose; mesosternum not carinate; Cent. Europe ....**Xanthosphaera** Fairm.*

F[2]. Elytra transversely strigose; mesosternum narrowly carinate; Cent. Africa ....**Hypoliodes** Port.

D[2]. Tarsi 5–4–4; elytra striate.

E[1]. Elytra not transversely strigose; antennal club five segmented with eighth segment narrower than seventh.

F[1]. Elytral striæ not impressed, except sutural, but represented by rows of punctures; New York..........**Cainosternum** Notman

F[2]. Elytral striæ obsolete except sutural; Sikkim, Java.
Liocolenis Port.**

E². Elytra transversely strigose.

F¹. Eighth segment of antenna not smaller than seventh; antennal club six segmented.

G¹. Elytra with punctate striæ; intervals punctate; Japan. **Pseudocolenis** Port.

G². Elytra without striæ other than sutural; Himalayas. **Liodinella** Port.

F². Eighth segment of antenna smaller than seventh; antennal club five segmented; Holarctic, Oriental, New Caledonia, Cent. Amer. (*Colensia* Fauv.–*Pseudoliodes* Port.–*Pseudocolenis* Champ. nec. Reitt.)........**Colenis** Er.

D³. Tarsi 4–4–5.

E¹. Antennal club six segmented; Sikkim........**Delios** Port.

E². Antennal club three segmented; Siberia........**Deltocnemis** Sahlbg.

D⁴. Tarsi 4–3–3; antennal club 5-segmented; Europe. *Agaricophagus* Schm.

B². Head with antennal groove beneath; except in *Cyrtusa* Er. the tibiæ with two longitudinal dorsal carinæ and the anterior tibiæ spinose; body more or less contractile........**AGATHIDIINI**

C¹. Head small; tempora short.

D¹. Antennal club five segmented.

E¹. Second segment of club not smaller than first; elytra without striæ; meso- and metatibiæ not spinose without; Japan. **Sphaeroliodes** Port.

E². Second segment of club smaller than first; meso- and metatibiæ spinose without.

F¹. Tarsi 5–5–4 or 5–4–4.

G¹. Elytra densely punctate; striæ present or absent; four proximal ♂ pro- and mesotarsomeres strongly dilated; tarsi 5–5–4 (♂), 5–4–4 (♀).

H¹. Labrum truncate; clypeus with frontal suture; Holarctic, Tasmania, Argentina (*Leiodes* Schm., Er.–*Liodes* Lacord., Lec., Seidl., Horn, Leng, etc.). **Anisotoma** Ill.

H². Labrum arcuate; clypeus without frontal suture; Indiana........**Stetholiodes** Fall.

G². Elytra not or feebly punctate; striæ present or absent; ♂ protarsomeres feebly dilated; ♂ mesotarsomeres not dilated; tarsi 5–5–4–; Japan........**Eucyrta** Port.

F². Tarsi 4–4–3–; procoxacavæ open behind; Cent. Amer. **Creagrophorus** Matth.

* The mesotarsi are unknown and may require the association of this genus with *Cainosternum* Notman and *Liocolenis* Port.

** Includes *Pseudocolenis lævipennis* Port., Java.

D². Antennal club four segmented.
E¹. Antennæ eleven segmented; without striæ.
F¹. Eyes not forming a sharp angle with tempora; Europe. **Liodopria** Reitt.
F². Eyes forming a sharp angle with tempora; Europe. **Amphicyllis** Er.
E². Antennæ ten segmented; Cosmopolitan..**Cyrtusa** Er.
D³. Antennal club three segmented.
E¹. Antennæ eleven segmented; eyes forming a sharp angle with tempora; Palaearctic..**Cyrtoplastus** Reitt.
E². Antennæ ten segmented.
F¹. Mesocoxæ narrowly separated; Mich., D. C. **Isoplastus** Horn
F². Mesocoxæ widely separated; Zanzibar..................**Isoplastinus** Port.
C². Head larger; tempora longer.
D¹. Eighth antennal segment scarcely narrower than seventh; tarsi 5–5–4 (♂), 5–4–4 or 4–4–4 (♀); antennal club three segmented ....**Agathidium** Ill.
E¹. Pronotum and elytra not evidently pubescent.
F¹. Humeri obsolete; body completely contractile; Oriental, Holarctic, Cent. Amer. (*Cyphoceble* Thoms. 1862). subg. *Agathidium* s. str.
F². Humeri evident, blunt; body incompletely contractile.
G¹. Head behind eyes indistinctly narrowed; Palaearctic. subg. *Neoceble* Gozis.
G². Head behind eyes with evident tempora, thence narrowed; Palaearctic. (*Agathidium* s. str. Thoms. 1862.—*Saccoceble* Gozis.)..subg. *Cyphoceble* Thoms.
E². Dorsum evidently pubescent; Maritime Alps. subg. *Chætoceble* Deville
D². Eighth antennal segment narrower than seventh; antennal club five segmented.
E¹. Tarsi 5–5–5 (♂); India..**Agathodes** Port.
E². Tarsi 5–4–4 (♂), 4–4–4 (♀); Caucasus..................**Ansibaris** Reitt.
E³. Tarsi 4–3–3 (♂), 3–3–3 (♀); N. Amer. (*Aglyptus* Lec.–*Aglyptonotus* Champ.)..**Aglyptinus** Cock.
A². Without eyes; tarsi three segmented; antennæ with five segmented club of which the second segment is smaller than the first; abdomen five segmented; Neotropical ....**SCOTOCRYPTINI**
B¹. Body oval or oval oblong.
C¹. Elytra with pubescence in part erect; Peru..................**Synaristus** Port.
C². Elytra glabrous, irregularly strigose; Guatemala.......**Parabystus** Port.
B². Body subtriangular; elytra without sculpture, only with pruinose pubescence.

C¹. Scutellum visible; tibia cylindrical; ♂ tarsi unmodified; Mexico to Brazil .... **Scotocryptus** Girard.
C². Scutellum very much reduced; tibia compressed; ♂ pro- and mesotarsomeres dilated; Bolivia .... **Scotocryptodes** Port.

CLAMBIDÆ

A¹. Elytra margined at sides with distinct epipleuræ; coxal plates narrow; antennæ eleven segmented, club three segmented, moderately distant from eyes at base; abdomen seven segmented; Alaska.
Empelus Lec.*
A². Elytra not margined at sides, without epipleuræ; coxal plates wide.
B¹. Head smaller and narrower than pronotum; pronotum with evident sides and posterior angles; antennæ close to eyes.
C¹. Antennæ ten segmented with two segmented club; head slightly narrower than pronotum; scutellum evident; Australasia, Oriental, Holarctic, Cent. Amer. .... **Clambus** Fisch.
C². Antennæ eight segmented with feebly indicated three segmented club; head much narrower than pronotum; scutellum very small; Europe, Syria .... **Loricaster** Muls.**
B². Head larger than pronotum and as broad; pronotum without sides and posterior angles; antennæ ten segmented with two segmented club; antennæ distant from eyes at base; dorsum densely pubescent; abdomen six segmented; S. Africa, Holarctic.
Calyptomerus Redtb.

KEY TO THE SPECIES OF *Colenis* ER.

The species of the genus *Colenis* Er. as delimited in the above key to genera may be defined as follows:
A¹. Elytral striæ distinct.
B¹. Head transversely strigose, at least at sides.
C¹. Pronotum transversely strigose.
D¹. Sutural stria entire.
E¹. Seventh antennal segment scarcely wider than eighth; length 1.7–2.2 mm.; Spain, France, Italy .... **bonnairei** Duv.

* **Acribus** Waterhouse, Galapagoes Is., is said to resemble *Clambus*. Antenna eleven segmented, club three segmented. The genus should be recharacterized by one having access to the type, which is probably in the British Museum.

** **Clambidus** Fauv., New Caledonia, is said to resemble *Loricaster*. Body oval, strongly convex; head scarcely retracted in thorax, almost vertical, narrow; mandibles and eyes prominent; pronotum somewhat expanded laterad; scutellum large, pentagonal; elytra squarely truncate at base; sutural stria distinct from middle to apex.

E². Seventh antennal segment twice as wide as eighth; length 1.3–2 mm.; Europe, Caucasus .... **immunda** Sturm.

D². Sutural stria obsolete in front of middle; length 1.25 mm.; Panama .... **punctulata** Matth.

C². Pronotum not transversely strigose; sutural stria nearly attaining scutellum; length 1.25 mm.; Guatemala.......... **crassicornis** Matth.

B². Head and pronotum not transversely strigose.

C¹. Elytral striæ regular, strongly punctate; intervals strongly punctate; length 2 mm.; Japan.......... **grandis** Port.

C². Elytral striæ sinuous, minutely punctate; sutural stria confined to apical declivity; length 1–1.1 mm.; Guatemala. **phalacroides** Champ.

A². Elytral striæ indistinct, except the sutural.

B¹. Sutural stria entire; head and pronotum not transversely strigose.

C¹. Antennal club black.

D¹. Sutural stria deep at base.

E¹. Narrower, legs and antennæ shorter; the seventh antennal segment normal; length 2 mm.; W. Almora (India). **rastrata** Champ.

E². Broader, legs and antennæ longer; the seventh antennal segment dilated into a broad oblong plate; length 2.5 mm.; Naini Tal (India).......... **disparilis** Champ.

D². Sutural stria faint at base; length 2.25 mm.; Kashmir. **indica** Port.

C². Antennal club dusky; length 2 mm.; Japan.......... **strigosula** Port.

B². Sutural stria obsolete in front of middle; pronotum not transversely strigose.

C¹. Head transversely strigose; length 1.5–2 mm.; Atlantic to Ill., Tenn., and Fla. .... **impunctata** Lec.*

C². Head not transversely strigose.

D¹. Testaceous, antennal segments six to ten infuscate; length 2.25 mm.; Nilgiri Hills (India) .... **hemisphaerica** Champ.

D². Rufo-testaceous, antennal club infuscate; length 1.5–1.8 mm.; W. Almora and Naini Tal (India).......... **estriata** Champ.

D³. Piceous, with front, base of pronotum, segments one to four and eleven of antenna, legs, and usually a patch just behind the base of the elytra testaceous; length 2–2.25; Nilgiri Hills (India), Ceylon .... **variicornis** Champ.

* Apparently close to *impunctata* Lec. is **caledonica** Fauv. from New Caledonia. Length 1.5 mm.; without sculpture except for numerous fine closely placed transverse striolæ on the elytra, a sutural stria which is impressed on the declivity, and scarcely visible transverse striolæ on the front.

NOTES ON SOME SOUTH AMERICAN MEMBRACIDÆ

BY FREDERIC W. GODING

The subjoined observations were made during the revision of the Membracidæ of South America and Antilles now being published.

Subfamily Centrotinæ

Mr. Buckton on page 172 in Monograph of the Membracidæ named and described as new the genus *Gibbomorpha* with two species, habitat unknown. Judging from the descriptions and figures the genus is synonymous with *Monobelus* Stal, his *G. parvula* (p. 192, pl. 41, f. 9) being *M. fasciatus* Fabr., and *G. aurea* (p. 193, pl. 42, f. 1) apparently *M. nasutus* Stal.

Subfamily Hoplophorioninæ

Among the Membracidæ collected at Huigra and Loja, Ecuador, by Dr. F. X. Williams and Prof. Clodoveo Carrion, were a number which proved to be examples of "*Membracis triangulum* Germ." the type of the genus *Hoplophora* Germ., heretofore unidentified, and congeneric with *Ochropepla corrosa* Fairm., the type of that genus. As *Hoplophora* is preoccupied, Kirkaldy renamed it *Hoplophorion,* which must include all species congeneric with *corrosa.* This change leaves the species listed under *Hoplophora* and *Hoplophorion* without a generic name, to supply which I herewith propose the name *Metcalfiella,* in recognition of the splendid work on the Homoptera done by Dr. Z. P. Metcalf. Some of the species have and some have not longitudinal rugæ on the sides.

As there appear to be no good structural characters justifying the separation of the genera *Potnia* and *Aconophoroides,* some of which have lateral rugæ and others without them, the latter name should be considered a synonym.

Subfamily Smiliinæ

Students of the Membracidæ have considered *Entylia triguttata* Germ. identical with *Acutalis tripunctata* Fairm; but a

critical inquiry into the question proves them to be distinct. On examination of a long series of *triguttata*, received through the courtesy of Dr. H. C. Severin, a wide variation of colors and markings was observed ranging from very pale yellowish brown to black, some of the examples being mottled anteriorly, other with variable yellow bands and spots, and covered with dense hairs. The posterior pronotal process was broad at base, then slightly broadened nearly to the apex which was rather abruptly pointed, the extreme tip always black with a subapical yellow band. The pronotum was densely punctured, dull, a yellow spot each side. The tegmina were clear hyaline, interior margins broadly covered by the pronotum, with 3 discoidal cells and 5 apical cells, terminal cell placed transversely, and destitute of a transverse brown band. The average length was 3 mm. Habitat, S. Dakota.

While examples of *tripunctata* were not available for study, Fairmaire's description and figure are so clear there should be no difficulty in recognizing it. He states that the pronotum is shining brown-black, (hence, doubtless lightly punctured), approaching the *Hoplophora* in form, the posterior process sharply pointed, a yellow point each side, the apex yellow. The tegmina are entirely free, have a transverse brown band, and 4 apical cells and no discoidal, terminal cell triangular as stated in the description of the genus as well as shown in the figure. It is 4 mm. long; habitat in Brazil, and Caracas, Venez.

From the above data it is clear that the two species are distinct—one belonging to *Vanduzea*, the other to *Acutalis*.

Subfamily Darninæ

Stal apparently recognizing that the name *Scaphula* was preoccupied renamed Fairmaire's genus *Rhexia* omitting, however, to include *semiatra* Fairm. Fairmaire gave the locality as "Coromandel," omitting to name the country. As the only district well known at the time by that name was "Coromandel Coast of British India," Stal believed the species was from that country. The city of Coromandel is located in the province of Minas Geraes, Brazil, from whence Fairmaire received material.

Scaphula and *Tristan* must be considered as synonyms of *Rhexia*.

It appears that Dr. Funkhouser was correct in placing *Heniconotus* as a synonym of the genus *Heteronotus*, Laporte, as no reliable characters are known to separate them. *Ernestopehlkia* Schmidt is another synonym, his *E. inermis* and *spinosa* being the male and female of *Heteronotus delineatus* Walker.

NEW MEMBRACIDÆ, VI

By FREDERIC W. GODING

Subfamily Darninæ

Cymbomorpha atromaculata new species.

Pale shining red with two black spots, strongly elevated, highest at middle of dorsum.

♀. Head triangular, base sinuate, ocelli equidistant slightly above center of eyes and distant from base, elevated along middle, sulcate each side at apex, clypeus extended one-half below genæ, tip acute.

Pronotum shining, pale red, densely finely punctulate, transversely impressed across base of metopidium, convex to strongly produced conical humerals, then compressed foliaceous to apex, dorsum arched from behind humerals, highest at middle, apical third abruptly narrowed above and laterally, slender, acute, nearly long as tegmina; a median concolorus percurrent carina the longitudinal sulcus extended on summit metopidium. A large black spot on dorsum above humerals sometimes fading to pale fuscous, another spherical black spot front of apex each side touching on median line.

Tegmina translucent brown to piceous, abruptly pale yellow on apical cells, a black spot on interior angle.

Body and legs brownish yellow. 10 x 3.5 mm. Tena, Cuenca, Ecuad. (Tate.)

Type in Coll., F. W. G.

Near *nigrofasciata* Fairm., differs in color, concolorous median carina, much more highly elevated, apical part more lengthily narrowed and more abruptly declivous, subapical black spots, and color and black spot on tegmina; also color of body and legs.

Hyphinœ yaguachiensis new species.

♀. Head triangular, base strongly convex, ocelli equidistant a dark yellow spot above each and black stripe between, clypeus extended one-third below genæ.

Pronotum fuscous and yellow irrorate the former predominant on dorsum, apical third yellow, tip black, a distinct yellow stripe extending from below tips of suprahumerals to and along lateral margins to join yellow apical part, a pale yellow rather indistinct large black punctured circular depression each side and a small black spot just behind; suprahumerals rather short, robust, conical, black, extended directly outward and convex

between them; metopidium less fuscous, median carina black, slightly swollen; dorsum convex or very obtusely tectiform, apex long as tegmina.

Tegmina piceous hyaline, totally punctate, costal cells and apical third dark yellow.

Body piceous, front and middle legs fuscous, hind tibiæ yellow. Long. cum teg. 11, lat. int. corn. 8 mm. Yaguachi, Ecuad. (*Campos.*)

The figure of *H. tau* Fowl., Biol. C. A., Hom. ii, pl. 6, f. 1, closely resembles this species; it differs in yellow margins, shorter posterior process, etc.

Type in Coll., F. W. G.

Anchistrotus buctoni new species.

besckii Buckt. Mon. Memb. p. 145, pl. 31, f. 2, variety. Amazons, Braz. Form of *besckii* Germ. with bulbous part broader, colors and pattern different. Head broad, triangular, with 2 fuscous stripes on vertex which enclose ocelli; pronotum fuscous, compressed at humerals then strongly swollen, a longitudinal stripe each side from base distant from lateral margins and terminating at a broader transverse band at highest point of the swelling, joined by another transverse band just behind humerals, pale yellow; also, a pale yellow band on posterior margin which includes the fuscous-banded middle spine; lateral spines fuscous. 8 x 4 mm.

Type in the Buckton Collection.

Subfamily Membracinæ

Guayaquila olseni new species.

Robust, finely punctulate, testaceous, densely golden pubescent; front horn strongly oblique, suberect, margins very narrowly piceous. Head concolorous, pubescent, base broadly arcuate, ocelli slightly nearer and above center of eyes, margins straight, apex rounded. Pronotum stout, front horn double longer than broad at base, margins nearly parallel very slightly narrowed toward summit, median carina distant from base, extended on margins horn and on posterior apex the latter slightly longer than abdomen; tegmina pubescent and fuscous to middle, apical half yellow hyaline, extreme apices fuliginous; body concolorous, legs pale yellow. ♀. Long. cum teg. 8, cum corn. 11, lat. 4 mm.

From Pricta, Honduras (*Bequaert*), through Mr. C. E. Olsen, to whom it is dedicated. Type in Mr. Olsen's collection. In American Museum of Natural History.

A NEW SEED-INFESTING CHALCID-FLY FROM CHINA

BY C. R. CROSBY AND NELLIE H. CROSBY

While making a study of the insects attacking the fruiting clusters of *Sophora japonica* at Peking in 1927-28, Dr. J. G. Needham reared a series of chalcid-flies from larvae infesting the seeds. They appear to be a new species.

Bruchophagus sophoræ new species.

Female. Length, 2.7 mm. Head, thorax and abdomen black. Antennæ black with the basal half of scape, tip of pedicel and ring-joint yellowish. Legs black with the following parts honey-yellow to pale yellowish: the tarsi of all legs; first leg, trochanter, distal third of femur and all of tibia except small indefinite black spot; second leg, extreme base and distal fourth of femur, base and tip of tibia; third leg, tip of femur and base and tip of tibia. Tip of sheaths of ovipositor honey yellow.

Head umbilicate-punctate. On the face the punctures in vertical rows, the dividing ridges more pronounced towards the mouth border from the middle of which they seem to radiate. From the base of the antennæ to the mouth there is a low broad ridge, nearly smooth. Pronotum, mesoscutum, scutellum umbilicate-punctate. Mesepisternum umbilicate-punctate; mesepimeron finely rugulose with a few larger punctures ventrally along the front and hind margins. Propodeum (Plate I, Fig. 1) nearly vertical, coarsely rugose on the sides with a shallow median depression in which the sculpture is finer. The depression bounded on each side by two or three more or less distinctly parallel ridges convergent behind. Abdomen smooth and shining. Petiole short, flaring in front with a median and two lateral processes. Scape of antenna (Plate I, Fig. 2) elongate, more slender towards tip. Ratio of length of antennal segments: scape, 21; pedicel, 6; funicle I, 7; II, 6; III, 6; IV, 6; V, 6; club, 14. Club broader than funicle segments. For wing venation see Plate I, Fig. 3.

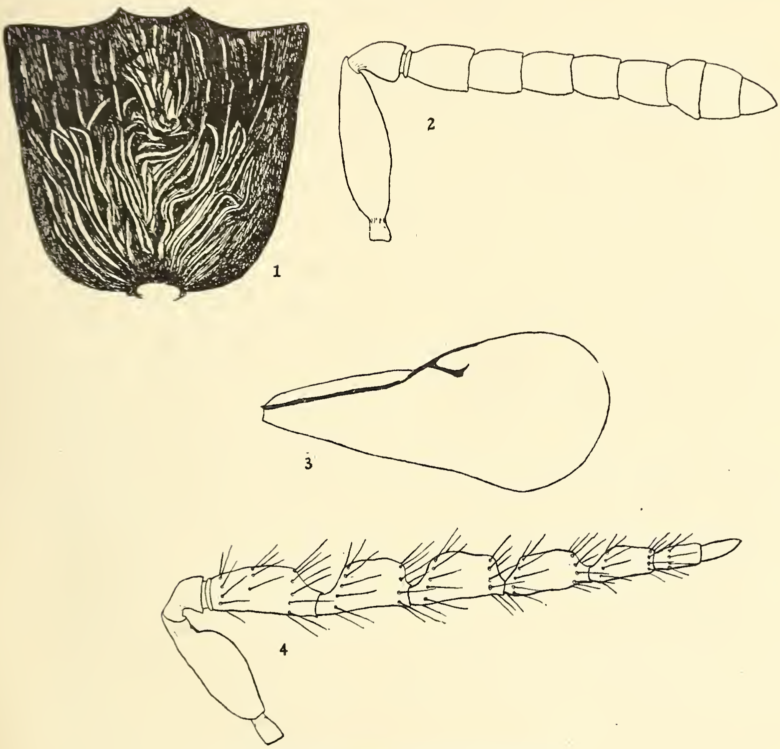
Male. Length, 2.2 mm. Similar to the female in color and sculpture but the legs have the black areas more reduced. Petiole finely rugulose, rather thick and extending backward nearly as far as hind coxae.

Antennæ (Plate I, Fig. 4) black except the basal half of scape and the ring-joint which are honey yellow; club pale. Scape swollen below; four funicle segments briefly pedunculate, arched above and armed with whorls of long hairs; club elongate, pointed. Ratio of length of antennal segments: scape, 19; pedicel, 5; funicle I, 13; II, 12; III, 12; IV, 11; club I, 8; II, 6; III, 6.

Holotype, female; allotype, male. Paratypes, 51 females and 31 males. All reared from seeds of *Sophora japonica* at Peking, China, July 15 to August 25, 1928, by Dr. J. G. Needham.

Larva. Length, 4 mm. Nearly white, rather thick and strongly curved. The mandibles brown, each with a small distinct tooth at the middle of the inner margin.

This species is closely related to *Bruchophagus mellipes* Gahan of India but may be distinguished by the color of the legs and of the scape of the antenna.



BRUCHOPHAGUS SOPHORÆ

STUDIES ON CHEMICAL CHANGES DURING THE LIFE CYCLE OF THE TENT CATERPILLAR (MALACOSOMA AMERICANA FAB.) IV. GLYCOGEN[1]

BY WILLEM RUDOLFS
BIOCHEMIST, NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS

Glycogen is an important constituent of muscle. The glycogen content of muscle varies and is greatly decreased by intense muscular activity. In men and herbivorous animals the liver stores the reserve supply of this "annual starch" and transforms it into glucose (called also grape sugar or starch sugar). The glucose is passed into the blood stream and so carried to the working muscle. Here the sugar is synthesized into glycogen and the glycogen thus formed is then changed into glucose whenever the working muscle may need it. The stored up glycogen is thus potential fuel for the muscles, but it must be changed to sugars before it can be used. Examination of living muscle shows granules, which may be glycogen.

The formation of polysaccharides (starch, cellulose, glycogen, gums, inulin, etc.) from monosaccharides (sugars) is probably an attribute of all living matter. The transformation apparently takes place very easily. We do not know, however, how this transformation is produced in living matter, although we can simulate the processes with chemicals in the laboratory. We know that in animal tissue synthesis of glycogen from glucose does not take place when a living cell is anesthetized and some investigators think that the respiration of the cell is in some way involved in the condensation of glucose into glycogen.

The amount of glycogen in different muscles and in the corresponding muscles of different animals is variable. Horse muscle, for instance, contains an unusually large quantity of glycogen, 1 to 2 per cent., and since glycogen can be detected in muscle microscopically by the brown reaction it gives with iodine, the

[1] Journal Series of the New Jersey Agricultural Experiment Stations. Department of Entomology.

presence of horse meat in sausages or other meat products can easily be determined. Another muscle containing large amounts of glycogen is that of the scallop, about 1.5 per cent., while ox flesh and other forms of muscle contain less. The glycogen content of muscles is subject to variation with the diet, but the variation is less than that of liver glycogen. In fasting glycogen disappears rapidly, while a large intake of glucose or other carbohydrates increases the glycogen content of both liver and muscles. The glycogen of muscle undergoes a rapid decomposition after death, and in beef which has hung for some time the amount of glycogen is much reduced. In hen's muscle 30 to 60 minutes after death 25–28 per cent. of the glycogen is lost and the reduction of glycogen in rabbit's muscle may after a few hours be as much as 90 per cent.

Certain substances and poisons cause a disappearance of glycogen in muscle. For instance, it has been found that arsenic causes the glycogen to disappear from the muscles of a cat. It would be very interesting to know what changes take place when arsenicals were administered to insects and the results would probably be very illuminating.

Methods and Material

The material used has been described in a previous paper (2). The glycogen was determined according to the official methods of the Association of Official Agricultural Chemists by boiling a quantity of material with water, treating it with alcohol and acidification with HCl. The final solution, containing the glycogen is neutralized with NaOH and reducing sugars determined in the regular way. The results obtained have been expressed as glycogen.

Results

The results secured are graphically shown in Figure 1. The amount of glycogen in the egg masses was small, namely 0.28 per cent. on a dry basis. No decrease in glycogen took place during the first stage when the larvae were formed. The amount of glycogen remained constant as far as the total egg masses were concerned. During the winter the glycogen decreased gradually. The frothy covers of the newly laid egg

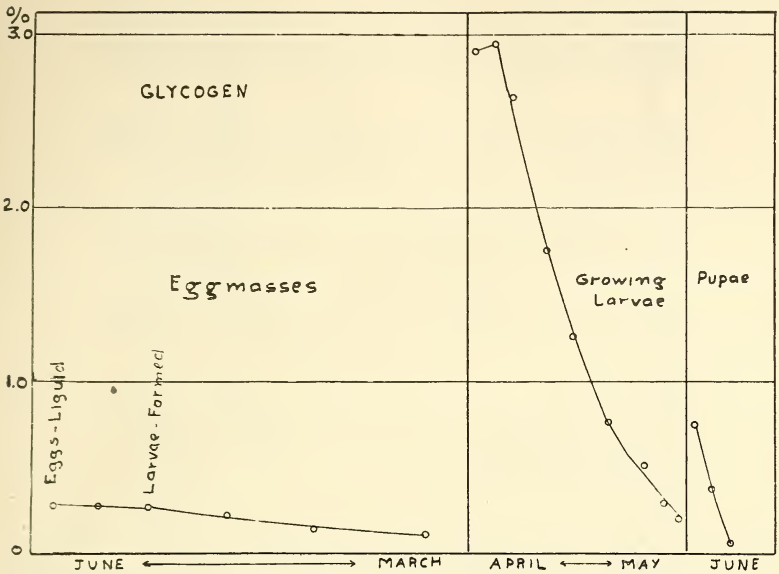


Fig. 1. Percentage glycogen present during the life cycle of the caterpillar.

masses contained nearly twice the amount of glycogen as the whole mass. Upon hatching the larvae contained 2.79 per cent. glycogen, which increased somewhat during the next few days and thereafter decreased rapidly until but little was left. This is in accordance with the findings of Vaney and Maignon (4) who studied the variations in glycogen occurring in the cocoons of the silkworm (*Bombyx mori*). Their detailed results are of interest and are therefore graphically shown in Figure 2. Unfortunately their results are expressed on the basis of wet weights of the insects and the moisture contents are not known. The silkworm cocoon has apparently much greater glycogen contents than the tent caterpillar ever amassed in any stage of its life cycle. If we assume that after eight days the cocoons of Vaney and Maignon had a percentage moisture of 75 per cent., the total glycogen on a dry basis would have been on that day not less than 6.0 per cent. The fluctuations in the curve might have been due to some extent to the variation in moisture content but the uniform reduction in weight of the cocoons suggest that

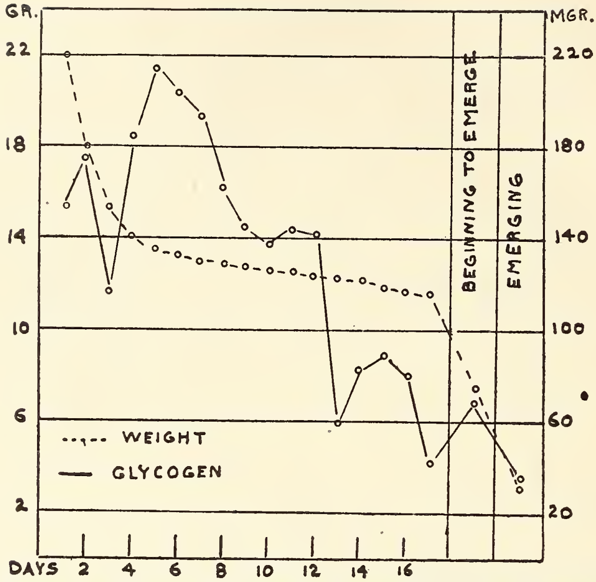


Fig. 2. Weight and amount of glycogen present in 10 nude cocoons of the silkworm.

the rapid decrease in glycogen after the fifth day was due to a consumption of glycogen. Shinoda (3) working with the wild silk moth (*Dictyoploca japonica*) found that the water soluble reducing sugars increased during the first few days when the larvæ were growing, but decreased rapidly thereafter. He found only traces of glycogen in the pupæ, although he had expected to find measurable quantities.

It is of decided interest to compare the changes in fat content with the changes in glycogen observed during the life cycle of the caterpillars (Fig. 3). The reduction of fats of the egg masses runs parallel with the reduction of glycogen, but in the growing larvæ fat accumulation took place whereas the glycogen per gram dry weight decreased in approximately the same ratio. This does not mean that the absolute fat increase was the same as the absolute glycogen decrease, but the rates of accumulation and disappearance were the same.

Since glycogen may be considered as important for muscle activity it is logical that the glycogen did not increase in the

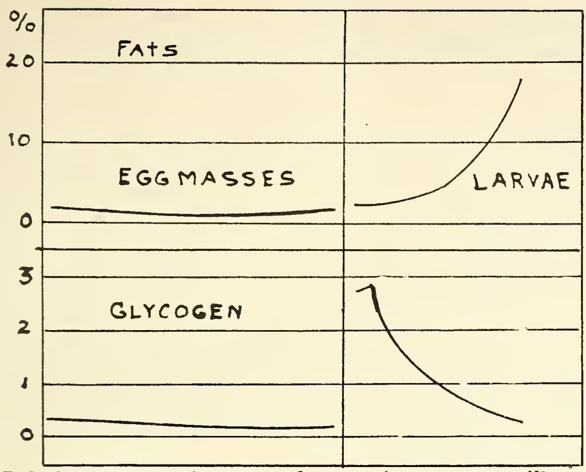


Fig. 3. Relation between fats and glycogen in tent caterpillars.

growing larvæ in relation to their growth, but the percentage decreased. However, the total amount of glycogen present in larvæ just after hatching was considerably less as compared with the total weight in the full grown larvæ. The wet and dry weight of larvæ upon hatching and of full grown larvæ, together with the amounts of glycogen present are given in table 1.

TABLE 1

RELATION BETWEEN WEIGHT OF LARVÆ AND AMOUNT OF GLYCOGEN

Age	Weight of 100 larvæ		Glycogen in 100 larvæ (dry)
	Wet	Dry	
	gr.	gr.	mgr.
Newly hatched	3.0	1.0	27.9
Full grown	642.0	50.7	375.0

The full grown larvæ contained actually 13 times more glycogen than the newly hatched, but their weight had increased at least 210 times. It is clear therefore that glycogen accumulation took place in order to supply the increased demand of muscle activity.

Glycogen transformation seems to be important in relation to the sex of the insect. Vaney and Maignon (4) made a study

of the glycogen content of silk worm moths. Their results are of sufficient interest to be given here (table 2).

Table 2

Difference in Percentage Glycogen of Males and Females

	Males	Females
Chrysalids (17 days)	0.755	0.636
Adults copulating	0.420	1.229
Adults after copulation and at play	0.888	1.300

It will be seen that the differences between the chrysalids are but slight, although the males contained somewhat more glycogen. After copulation the females were much richer in glycogen than the males.

It would seem that different cells and muscles of the tent caterpillar adult are concerned with glycogen transformations. With the aid of the iodine and gentian-violet staining method the writer was able to determine considerable quantities of glycogen in the leucocytes, muscles and the fat glands. The eggs present in the body of the female seemed also to contain glycogen, which indicates that during the transformation of the liquid egg to the larvæ possibly but little of the stored up glycogen was used. During this transformation the fats decreased appreciably which might mean that fats play during this particular part of the life cycle a more important rôle than glycogen.

When muscles are very active there is a great diminution in glycogen content of the muscle. Glycogen is used up and the energy for the work may come therefore from the glycogen. The question is whether this glycogen is the only source of the energy. The amounts of glycogen in the body are small and it would seem that the glycogen present would soon be used up. Naturally, the glycogen can quickly be reformed, but since fats first increase and later decrease during the pupation processes and the glycogen content changes in a similar fashion, it is either possible that fats as such are used or that they are partially decomposed and resynthesized into glycogen.

Arsenic causes the disappearance of glycogen, while Arnold (1) states that glycogen is best fixed by mercuric chloride con-

taining some glucose. It may be possible that such facts can be utilized in insect control when we know more about the chemistry and physiology of insects.

SUMMARY

The glycogen content of the apple tent caterpillar changes during the different phases of its life cycle. The greatest changes take place when the larva is actively feeding and although the percentage of glycogen decreases in respect to the dry weight, the actual amount increases about 13 times. No great changes occur during the transformation of liquid eggs into larvæ. During the pupal stage the glycogen disappears, rapidly indicating that it plays an important rôle. Glycogen was found in the leucocytes, muscles, fat glands and eggs.

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(2) RUDOLFS, 1926. Journ. N. Y. Ent. Soc. xxxiv, 249, 320; xxxv, 219.
(3) SHINODA, 1925. Mem. Coll. Sci. Kyoto Mip. Univ. IX, 225.
(4) VANEY and MAIGNON, 1905. Compt. Rend. Acad. Sci. (Paris) *140*, 1192, 1280.

AN APPARATUS FOR THE STUDY OF COMPARATIVE EFFECTS OF CONSTANT VERSUS VARIABLE TEMPERATURES ON THE SPEED OF INSECT METABOLISM[1]

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INTRODUCTION

Among students of insects, studies of the relative effect of variable and constant temperatures has led to almost diametrically opposed conclusions. Furthermore, the integration of extensive studies of the effect of constant temperatures with extensive studies upon the effect of variable temperatures, which a knowledge of this relationship would make possible, might very well lead to the better interpretation of the effects of variable temperatures recorded by the United States Weather Bureau for so many years.

With the idea of arriving at an understanding of this relationship between the effects of variable and constant temperatures the writer has constructed a piece of apparatus which is described in the following report.

PRINCIPLES INVOLVED IN THE APPARATUS

Temperature Control

Obviously to get anywhere with a study of this sort the temperatures employed, whether variable or constant, must be under a control of the student and obviously also the range which they cover must be within the active cycle of the insect or insects studied. In this apparatus this control has been provided by employing an electric refrigerator capable of holding temperatures within a swing of four or five degrees down to a point as low as thirty-two degrees F. In this refrigerator are placed two insulated boxes each of which is fitted with a heating element under thermostatic control. By setting these thermostats the

[1] Paper of the Journal Series, New Jersey Agricultural Experiment Stations, Department of Entomology.

falling temperature within the box is arrested and held at the desired working point. The thermostat employed for this purpose in the constant temperature box is a simple bimetallic plate and a firmly set contact point, while the thermostat employed in the variable temperature box consists of a bimetallic plate and a constantly moving contact element. This contact element is under control and follows the revolution of a clock wheel which is completed every twenty-four hours. By this means for approximately twelve hours the contact point is moving away from the bimetallic plate and for the succeeding twelve hours the contact point is constantly moving toward the bimetallic plate. This arrangement produces a minimum and a maximum temperature every twenty-four hours, which by varying the position of the bimetallic plate may be made to swing between different highs and lows.

In the apparatus diagramed as Plate II battery controlled relays are employed because the thermostatic points are sufficiently delicate to be burned by the 110-volt 60-cycle current available.

Moisture Control

Since it has been shown by various workers that atmospheric moisture has a decided bearing upon insect metabolism, especially when dealing with certain species, it is obvious that that should be rendered constant. Fortunately it has been shown that the amount of water given off to an air stream bubbling slowly through a saturated solution of common salt is practically the same whether the temperature is ninety or fifty degrees F. or at any point between.

All, therefore, that is necessary to control atmospheric moisture and eliminate it as a variable factor is to dry the air by bubbling it slowly through concentrated sulphuric acid and raise its moisture content to about 73 per cent. by bubbling it slowly through a saturated equeous solution of common salt.

Gas-Constitution-of-the-Air Control

Since it has been shown by various workers that a reasonable supply of fresh air is necessary to the maximum activity of insects under experimentation this factor is provided by passing

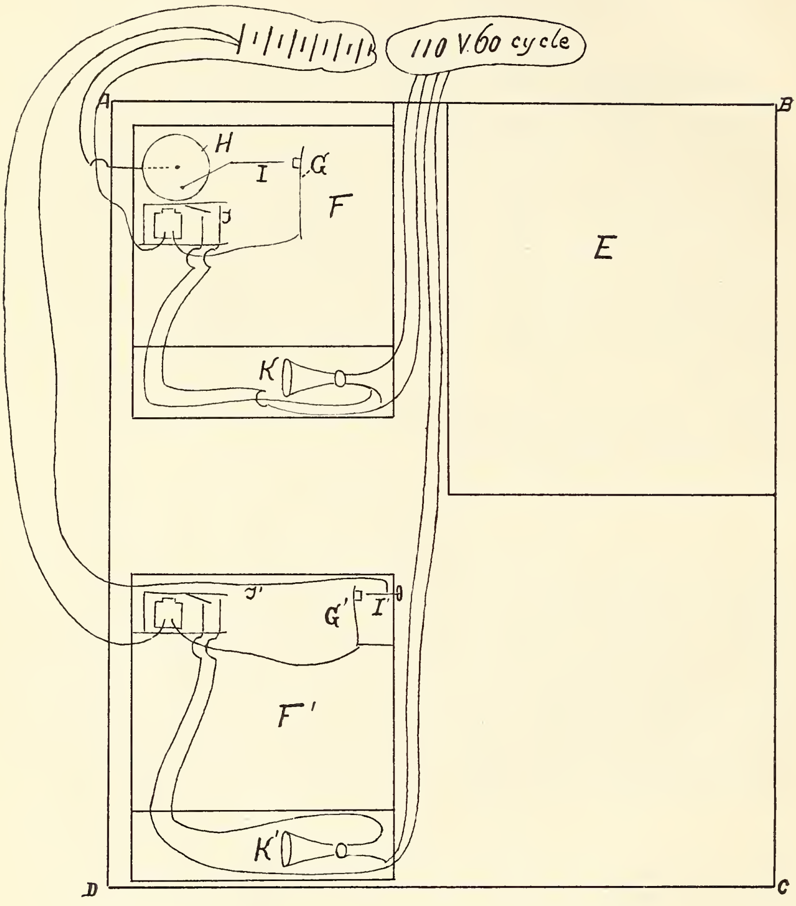
air, conditioned as to temperature and atmospheric moisture, through the containers holding the insects at the rate of about one liter every ten minutes.

Light Control

Since it has been shown by various workers that if the light is allowed to vary, the insects under experimentation are influenced and have their metabolism modified by it, it is, of course, necessary to control that factor. This control has been accomplished by shutting out the light. The heating units produce a red glow, which, however, in view of the fact that they are located in this apparatus in the lower chamber and shut off from the one which contained the insects by more than a quarter of an inch of asbestos board, would seem unlikely to introduce a serious variable. Of course it would be possible to introduce in the place of the asbestos board material definitely known to screen out red and infra-red rays.

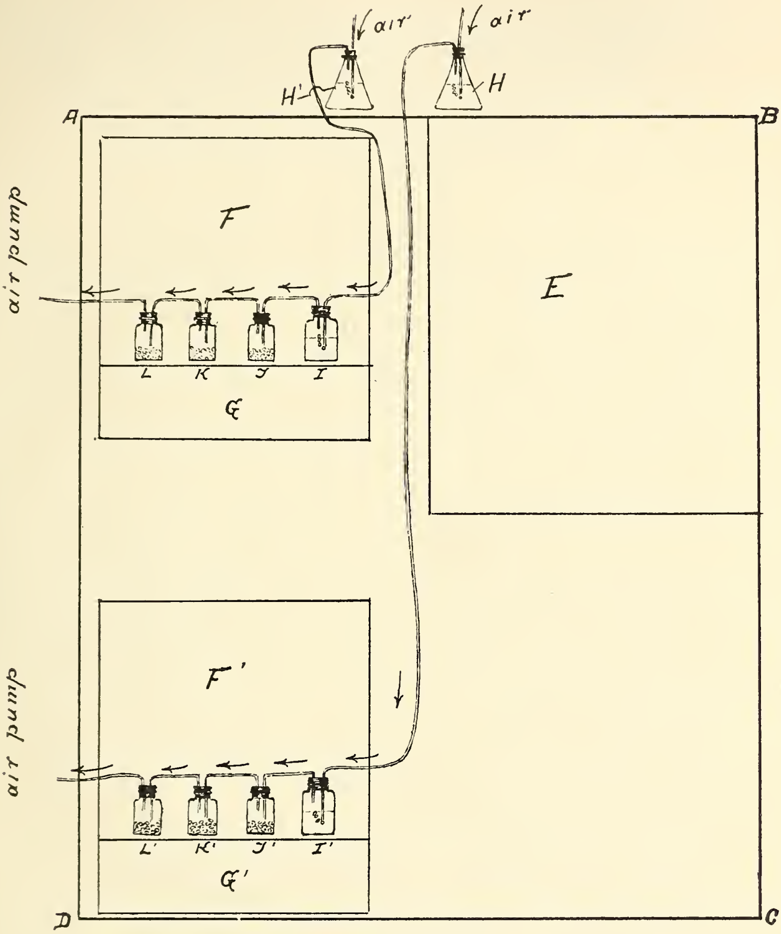
CONCLUSION

Thus it seems that the variables other than temperature have been reduced to zero or at least to a negligible point permitting direct experimentation with a controlled constant versus a controlled variable temperature. The procedure of the writer in carrying on these experiments has been to run the constant temperature box at the average of the variable and to adjust the range of the variable on the basis of the average range of active temperatures for the insect with which he is working.



Temperature Control

A B C D, electric refrigerator; E, cooling element; F, insect chamber, variable temperature; F′, insect chamber, constant temperature; G G′, thermostat plate; H, clock work wheel (complete revolution each 24 hours); I I′, thermostatic contact point; J J′, relays; K K′, heating chambers.



MOISTURE CONTROL

A B C D, electric refrigerator; E, cooling element; F, insect chamber, variable temperature; F′, insect chamber, constant temperature; G G′, heating chambers; H H′, sulfuric acid bubblers; I I′, saturated solution of sodium chloride bubblers; J K L and J′ K′ L′, insect containers.

THE DISTRIBUTION OF THE BEACH-GRASSHOPPERS TRIMEROTROPIS HURONIANA AND TRIMEROTROPIS MARITIMA INTERIOR IN THE GREAT LAKES REGION (ORTHOPTERA: ACRIDIDÆ)[1]

BY T. H. HUBBELL

A number of years ago Mr. Sherman Moore, of Detroit, sent me three specimens of a grasshopper which he had taken on the beach of Horseshoe Bay, five miles north of St. Ignace, Mackinac Co., Michigan. It was with considerable interest that I recognized the species as *Trimerotropis huroniana* E. M. Walker, described from Southampton, Ontario, in 1902, and not reported since that time. Since the finding of these first specimens, the species has been taken in a number of localities along the shores of the northern Great Lakes, and in 1925 I reported it in a preliminary way from several counties in Michigan.

Since the Great Lakes race of another species of the genus, *Trimerotropis maritima interior* E. M. Walker, is also found in the region, it became an interesting problem to determine the limits of distribution of the two, especially as certain records of the latter species seemed to indicate an overlapping of their ranges, while other facts pointed to a replacement of one species by the other in their respective territories. Recently I have had the opportunity of studying and rearranging the large collection of Michigan Orthoptera in the Museum of Zoology of the University of Michigan, and in the course of this work I found it necessary to examine all the material of this genus contained in the collection. When this was done it became evident that there had been some confusion of the two species, and consequent misunderstanding of their distribution.

All of the material recorded below is in the above mentioned collection, with the exception of two specimens in the collection

[1] Contribution from the Department of Biology, University of Florida, Gainesville, Florida.

of Mr. Sherman Moore and one in that of the Michigan State College.

Trimerotropis huroniana E. M. Walker.

1902. T. huroniana E. M. Walker, Can. Ent., xxxiv, 6, figs. 8–13 [Southampton, Ont.]
1911. T. maritima var. interior Shull, Publ. 4, Biol. Ser. 2, Mich. Geol. & Biol. Surv., 226 [Sand Point, Huron Co., Michigan].
1920. T. huroniana Blatchley, Orth. Northeastern Amer., 298 [Southampton, Ont.].
1920. T. maritima Blatchley, l. c., 294 (in part) [Huron Co., Michigan].
1925. T. huroniana Hubbell, Florida Ent., ix (3), p. 44 [Schoolcraft, Mackinac Emmett, Charlevoix, Leelenau and Grand Traverse Cos., Michigan].

Michigan: Port Austin, Huron Co., Aug. 26–27, 1924 (F. M. Gaige) 8 ♂, 6 ♀; Sand Point, Huron Co., July 6–Aug. 3, 1908 (A. F. Shull) 2 ♂, 7 ♀;[2] Harrisville, Alcona Co., Aug. 10–15, 1921 (F. M. Gaige) 9 ♂, 13 ♀; Big Stone Bay, Emmett Co., July 30, 1921 (Hubbell) 10 ♂, 12 ♀; July 30, 1927 (H. B. Baker) 1 ♂; Cross Village, Emmett Co., Aug. 2, 1924 (S. Moore) 1 ♂; Norwood twp., Charlevoix Co., Aug. 6, 1923 (Hubbell) 1 ♂, 5 ♀; Hog Island, Charlevoix Co., July 26–28, 1921 (Hubbell) 9 ♂, 21 ♀; Beaver Island, Charlevoix Co., Aug. 2, 1922 (S. Moore) 2 ♂, 1 ♀; Leland, Leelenau Co., July 30, 1921 (R. T. Hatt) 1 ♀; North Fox Island, Leelenau Co., Aug. 2, 1922 (S. Moore) 1 ♂, 1 ♀; Marion Island, Grand Traverse Co., July 25, 1923 (Hubbell) 3 ♂, 1 ♀; Traverse City, Grand Traverse Co., 1 ♂ (Coll. Mich. State Coll.); Horseshoe Bay, 5 miles north of St. Ignace, Mackinac Co., July 11, 1920 (S. Moore) 3 ♂ (2 specimens in Coll. S. Moore); July 24, 1921 (Hubbell) 39 ♂, 45 ♀; Naubinway, Mackinac Co., July 8, 1921 (S. Moore) 1 ♂, 1 ♀; July 29, 1921 (Hubbell) 2 ♂, 4 ♀; Manistique, Schoolcraft Co., July 25–26, 1922 (S. Moore) 3 ♂, 1 ♀; Whitefish Point, Chippewa Co., July 21–27, 1914 (W. S. McAlpine) 1 ♂, 1 ♀.

It is evident that this species replaces *Trimerotropis maritima interior* on the northern shores of the Great Lakes, though its limits of distribution are as yet little known. In the region of

[2] These specimens are the basis of Shull's 1911 record of *T. maritima* var. *interior*.

the Straits of Mackinac *Trimerotropis huroniana* is everywhere abundant on the sandy lake beaches. From this region it extends southward along the west shore of Lake Huron at least as far as the tip of the "thumb"; on the Ontario shore it occurs at Southampton, and probably northward throughout the Georgian Bay region and along the north shore to the Straits. *T. huroniana* follows the north shore of Lake Michigan west of the Straits of Mackinac at least as far as Manistique, is found on the islands in the northern end of the lake, and extends down the Michigan shore as far as Leland and Traverse City, and probably beyond. Additional field work is needed to determine whether the ranges of *T. huroniana* and *T. maritima interior* meet on the Lake Michigan shore, and if so, at what point. North of the Straits region the species reaches the eastern end of Lake Superior (Whitefish Point); how far it follows the beaches of this lake is not known. Hebard did not find it in Baraga county, nor did I encounter it on the shore of Lake Superior near the Huron Mountain Club in Marquette county.

The habitat of *Trimerotropis huroniana* on Hog Island, in northern Lake Michigan, is typical of the situations in which it occurs in the Straits region. At this locality it was found to be abundant on a quarter-mile stretch of somewhat protected sandy beach, at the head of a small bay on the west shore of the island. On either side the sandy shore gave place to beaches of sharp shingle, where the species did not occur; nor have I found it elsewhere under such conditions. At the head of the bay the bare sand of the lower beach slopes upward from the strand-line to a slight ridge, which supports an irregular growth of sand willows, beach cherry, and beach grass. Between this zone and the edge of the forest the upper beach is covered with a scattered growth of grasses and xerophytic herbage, which gives place along the shoreward margin to mats of bear-berry (*Arctostaphylos uva-ursi* (Linn.), and *Juniperus horizontalis* Moench., and clumps of *Juniperus communis siberica* Burgsd., the two latter forming a low marginal thicket at the edge of the forest of white cedar, white spruce, birch and a few other trees.

Trimerotropis huroniana was found in greatest numbers on the dry sand among the scattered grasses, herbage and shrubbery of

the upper beach, although occasional specimens were found to the edge of the strand. The species is very alert, but seldom flies far, and is more easily captured than *T. maritima interior.* Its stridulation is not loud; it is well described by Walker. Associated with *T. huroniana* on the beach at Hog Island were the following species of Orthoptera: *Acrydium acadicum acadicum* (Sc.) (scarce on upper beach), *Nomotettix cristatus cristatus* (Sc.) (scarce on upper beach), *Chorthippus curtipennis curtipennis* (Harris) (scarce), *Dissosteira carolina* (Linn.) (scarce), *Circotettix verruculatus* (Kirby) (numerous), *Camnula pellucida* (Sc.) (abundant), *Melanoplus mexicanus mexicanus* (Sauss.) (abundant), *Melanoplus femur-rubrum femur-rubrum* (DeG.) (scarce), *Melanoplus confusus* Sc. (scarce), *Melanoplus keeleri luridus* (Dodge) (scarce), *Melanoplus fasciatus* (F. Walker) (scarce), *Melanoplus islandicus* Blatchley (a few in the marginal thicket of Junipers), *Scudderia pistillata* Brunner (on shrubbery of upper beach), *Gryllus assimilis* (Fabr.) (common under beach debris), *Nemobius griseus* E. M. Walker (moderately common on upper beach, especially in the Juniper thicket). In a similar situation at St. Ignace the following additional species were taken with *T. huroniana: Scirtetica marmorata marmorata* (Harris), *Melanoplus packardii stonei* Rehn, and *Conocephalus fasciatus fasciatus* (DeGeer). In this locality a male *Trimerotropis huroniana* was taken in copula with a female *Circotettix verruculatus* (Kirby); the pair is mounted in this position. Such cases of miscegenation are not uncommon in the Acrididæ, and seem to be somewhat more frequent among the Oedipodinæ than in the other subfamilies.

The general facies of *Trimerotropis huroniana* is usually quite different from that of *T. maritima interior.* In most instances they are easily separated by color characters alone, but occasional specimens show a close superficial resemblance to the other species. The tegmina of *huroniana* vary from a banded type, with dark, rather solid fasciæ contrasting distinctly with the light ground color, through various intermediate conditions, to those of a uniform brownish or grayish color. Specimens with the latter type of coloration sometimes resemble *T. maritima interior* in appearance; but in *huroniana* the tegmina nearly always

retain traces of the solid proximal band and usually of the the median band, while in *maritima interior* the base of the tegmen is seldom noticeably darker than the mesal portion, the proximal band being narrower and scarcely suffusing the base. Uniformly colored individuals of *huroniana* are frequently of a bright ferrugineous color; such individuals would scarcely be taken for the same species as others of the paler, contrastingly-banded type. All variations of color and pattern are usually represented in the same restricted area of beach, and among mating pairs the two insects are as often of different as of similar coloration. In this species the disk of the wing is a more dilute yellow than is the rule in *maritima interior,* and it has a faintly more greenish hue than in that species. The wing band is seldom as dense as in the more recessive condition of *maritima interior* found on the shores of southern Lake Michigan, and never approaches the deep black of typical examples of that race from Ontario; frequently it is merely infumate. Furthermore it is relatively narrow (though the width varies considerably), and often interrupted or narrowed anteriorly, resembling in this respect the more recessive examples of Lake Michigan *maritima interior;* in the typical condition of that race it is almost uniformly broad and continuous. The most constant color difference between the two species is found in the lower sulcus of the caudal femora; in *huroniana* this is typically black, with one preapical light band, in *maritima interior* light with two black bands. In occasional specimens of *huroniana,* however, the black suffusion is weakened until the condition resembles that found in heavily suffused examples of *maritima interior.* Another more variable color character has been used by Blatchley in his key to the eastern species of the genus—the coloration of the internal surfaces of the geniculæ of the caudal femora; in *huroniana* these are usually dark, and in *maritima interior* usually light in color, but the reverse is true of some specimens of *huroniana* from Hog Island, Harrisville and St. Ignace, and of all the material of *maritima interior* recorded below from Goderich, Ontario.

The structural characters separating the two species are less variable and more to be relied upon in exceptional cases. The antennæ of *maritima interior* are distinctly longer and heavier

than those of *huroniana;* and the fastigium of the vertex, while somewhat variable in form, is noticeably longer in the latter species. The most characteristic difference is found in the structure of the pronotum. In *huroniana* the prozona is more compressed, and the anterior prozonal lobe is noticeably longer and slightly more elevated than the posterior; both lobes rise distinctly above the plane of the metazona. In *maritima interior* the dorsum of the prozona is lower and more rounded, and appears somewhat longer in proportion to the metazona; the two lobes of the prozona are almost equal in length, of about the same height, and but little elevated above the plane of the metazona. Walker's description and figures of *T. huroniana* are excellent, and illustrate most of these points.

Trimerotropis maritima interior E. M. Walker.

1898. T. maritima interior E. M. Walker, Can. Ent., xxx, p. 262 [Toronto and Kingsville, Ontario].

1920. T. maritima Blatchley, Orth. Northeastern Amer., 293 [In part].

1922. T. maritima Hubbell, Occ. Pap. Mus. Zool. Univ. Mich., No. 116, 45 [Berrien Co., Michigan].

ONTARIO: Goderich, Huron Co., July 26, 1921 (A. W. Andrews) 1 ♂, 4 ♀.

MICHIGAN: St. Joseph, Sawyer Dunes, New Buffalo, Berrien Co. (previously recorded); Port Huron, St. Clair Co., summer 1921 (A. W. Andrews) 1 ♀; Monroe, Monroe Co., Aug. 18, 1922 (C. L. Hubbs) 1 ♂.

The typical race of this species is found along the Atlantic coast from Pine Point, Maine (Morse) south to Atlantic Beach, Florida (Rehn & Hebard). The status of Walker's race *interior* is at present somewhat doubtful. It was described from localities on the north shores of Lake Ontario and Lake Erie, and has since been recorded from additional localities on these lakes, from Walpole Island, St. Clair River, and from near Sarnia, at the southern extremity of Lake Huron. The series recorded above from Goderich and the specimens from Port Huron and Monroe are typical of this race, having broad solidly black wing-bands, and being smaller than Atlantic Coast specimens.

Westward *Trimerotropis maritima* is abundant about the southern end of Lake Michigan, having been recorded from

Michigan (Hubbell), Indiana (Blatchley) and Illinois (McNeill); Blatchley has taken it on the shores of small lakes in northern Indiana, and Somes[3] states that it is found on the sandy flats of the Mississippi River in southern Minnesota. I have seen only Lake Michigan specimens from this portion of the range of the species, and cannot say whether the Minnesota specimens agree with them or not. Lake Michigan specimens, at any rate, are not typical of race *interior,* but apparently are intermediate between the condition found in that race and the typical condition. While the Ontario specimens recorded above have the wing band uniformly broad and densely black, in the Lake Michigan material, which is quite variable, it averages narrower and less densely colored, and in nearly all the specimens is distinctly narrowed or entirely interrupted caudad of the subcostal taenia. Occasional specimens from this region are scarcely separable from Atlantic Coast material. However, I am regarding all the specimens from the Great Lakes region as *Trimerotropis maritima interior* for the present, since the coloration averages more intensive, the size somewhat smaller, and they present in general a recognizable facies distinct from that of Atlantic Coast specimens.

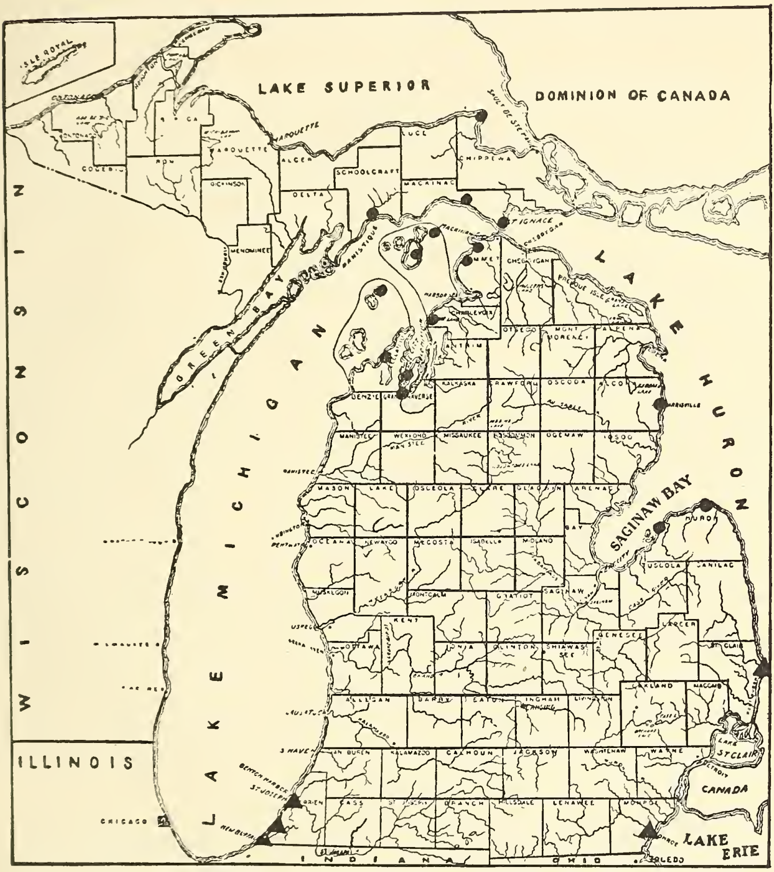
Reexamination of the material shows that Shull's record of *Trimerotropis maritima* var. *interior* from Sand Point, Huron Co., Michigan, on the authority of A. P. Morse, is instead referable to *T. huroniana.* The specimens are typical of the species except for the unusually elongate wings of a few of the females. They are light colored, of the unbanded phase, and somewhat resemble the other[4] species; the ease with which the two may sometimes be confused is shown by the fact that so careful a worker as Rehn examined part of the material in 1919 and confirmed Morse's determination.

Blatchley repeats this record, and gives, on my authority, the additional locality of Chippewa county, Michigan. Reexamination of the material shows that it is correctly determined, but I believe the locality to be erroneous. The record is far north of all others for the species; furthermore, Mr. W. S. McAlpine collected two specimens of *T. huroniana* at the locality from which

[3] Somes, M. P. 1914. Bull. Div. Ent. Minn. Agr. Exp. Sta., No. 141, 60.

these are supposed to have come. This record was based on two specimens given to the University of Michigan Museum by Mr. A. W. Andrews, of Detroit; they bore colored labels which indicated that they had been taken on the shore of Lake Superior at Whitefish Point, Chippewa Co., Michigan, in 1914. At the time when they were given to the Museum Mr. Andrews had also collected on the shore of Lake Michigan in Berrien county, and I believe the specimens were probably taken in that locality. They agree with other Berrien county material at hand, except that the coloration is unusually light, and the wing-bands fainter than usual, so that they might well be referred to the Atlantic Coast race; Rehn saw them in 1919 and stated that they were apparently typical *maritima.*

From the data available the distribution of *Trimerotropis maritima interior* may be summed up as follows: it is a race (?) characteristic of the southern portion of the Great Lakes district, being entirely replaced to the north by *Trimerotropis huroniana.* In the eastern part of its territory it is typical, occurring along the shores of Lake Ontario and Lake Erie, and following the Detroit River, Lake St. Clair and the St. Clair River to the southern end of Lake Huron. On the Ontario shore of this lake it extends northward to a point between Goderich (the northernmost known locality in this region) and Southampton, where *T. huroniana* is known to replace it; on the Michigan side of the lake it does not reach the tip of the "thumb," as all of the Huron county material belongs to the other species. *Trimerotropis maritima interior* reappears again on the southern end of Lake Michigan in an atypical recessive condition, and has a discontinuous distribution along the sandy shores of lakes and large rivers westward to southern Minnesota. The extent of its northward distribution on the shores of Lake Michigan is not known.



The Michigan records of *Trimerotropis huroniana* E. M. Walker (circles) and *Trimerotropis maritima interior* E. M. Walker (triangles).

NOTES AND ADDITIONS FOR 1928 TO THE NEW YORK STATE LIST (LEPIDOPTERA)

BY ALEX. B. KLOTS
ITHACA, N. Y.

Lyonetiidæ

Bucculatrix quinquenotella Chambers. Ithaca, July 9, collected by writer at light. Not previously recorded from the state. Determined by the writer.

Gracilariidæ

Gracilaria syringella Fabr. Bred by P. Harwood from larvæ on lilac, July 6, Philadelphia, N. Y. Determined by W. T. M. Forbes.

Micrurapteryx kollariella Zeller. Ithaca, July, collected on *Melilotus alba* by Morris Stewart. A European species not previously recorded from the United States. Determined by W. T. M. Forbes.

Saturniidæ

Samia columbia Smith. A cocoon on hemlock (*Tsuga*), Lick Brook, Aug. 12, collected by M. Zaitzev, a Russian delegate to the Fourth International Congress of Entomology. Another cocoon in possession of Mr. T. H. Eaton. Determined by W. T. M. Forbes. The specimen collected by M. Zaitzev was hastily annexed to the Cornell U. collection.

Nymphalidæ

Phyciodes tharos f. ab. *packardii* Saunders (=*reaghi* Reiff). McLean, July 6, collected by writer. Whether this suffused aberration is worth the retention of a name is doubtful. A similar form, fortunately not named, occurs of *P. batesii* Reakirt, of which a specimen is in the Cornell collection.

Pieridæ

Eurymus eurytheme Boisduval. This species has suddenly appeared in considerable numbers everywhere around Ithaca,

having been taken by the writer at the following localities: Cornell Campus, on the streets of Ithaca, Ellis Hollow, McLean, Lick Brook, Buttermilk Falls, Mecklenberg, Taughannock State Park, and Connecticut Hill (altitude 2,095 ft.). The first record was a f. *amphidusa,* taken at Lick Brook, Aug. 12, by Mr. T. H. Eaton. A f. *eriphyle* ♂ was taken by the writer at the same locality and date. A female f. *eurytheme* (f. *keewaydin*) was taken by Mr. Brower at Lick Brook on Aug. 19.

This sudden abundance of *eurytheme* is most unexpected, inasmuch as the species has not been previously recorded from Ithaca. As seen above most of the forms have already been taken. *Eriphyle* and *keewaydin* have not been heretofore recorded from the state. The species may conceivably increase so as to be a pest to alfalfa growers, as it is in some parts of the Middle West.

Genitalically *eurytheme* and *E. philodice* are distinct, although close. Examination of the organs of suspicious looking *philodice* males may furnish additional records of *eriphyle* and possibly of *autumnalis.* The writer believes that very possibly more or less natural hybridization occurs between *eurytheme* and *philodice.* That such is possible has been demonstrated by Professor Gerould, of Dartmouth.

THE ENTOMOLOGY OF MARTIN LISTER, PHYSICIAN, NATURALIST AND ANTIQUARIAN

BY HARRY B. WEISS
NEW BRUNSWICK, N. J.

Toward the close of the seventeenth century, when Dr. Martin Lister was practicing in London, and while he was a member of the Royal College of Physicians, Ned Ward, in his *London Spy,* was picturesquely describing the college, its members and their privileges. He said in part six of his then popular publication, "No Person, tho' a Graduate in Physick of *Oxford* or *Cambridge,* and a Man of more *Learning, Judgment* and *Experience* than one half of their *Members,* shall have the Liberty of Practicing in, or within Seven Miles of *London,* without *License* under the *College Seal;* or in any other part of *England,* if they have not taken some Degree at one of the *Universities;* they have also Power to Administer an *Oath,* which they know by Experience, is as Practicable to be broke the next Day, as 'tis to be taken; they can likewise *Fine* and *Imprison Offenders,* in the Science of *Physick,* and all such who presume to Cure a *Patient* when they have given 'em over, tho' by more Excellent Methods than ever were known to their Ignorance: They have also the Priviledge of making *By-Laws,* for the Interest of themselves, and Injury of the Publick, . . . they have Authority to Examine the Medicines in all *Apothecaries Shops,* to Judge of the *Wholesomeness* and *Goodness* of many *Drugs* and *Compositions* they never yet understood; they are likewise Exempt from Troublesome Offices, as *Jury-Men, Constables,* &c., being noways oblig'd to keep *Watch* or *Ward,* except with a *Rich Patient,* where they are assur'd to be well paid for their Labour; they have also the Liberty to Kill as many as they please, provided they do it *Secundum Artem,* and no *Law* shall call them to an Account. They are freed from the bearing of *Arms,* or providing of *Ammunition,* except *Pill, Bolus,* or *Potion,* or such as destroy the

Bodies of *Sick Persons* they know not how to Cure: . . . They rail mightily in their Writings against the Ignorance of *Quacks* and *Mountebanks,* yet for the sake of Lucre, they License all the Cozening Pretenders about Town, or they could not Practice; which shews it is by their Toleration that the People are Cheated out of their Lives and Money; and yet they think themselves so Honest, as to be no way answerable for this Publick Injury; as if they could not kill People fast enough themselves, but must Depute all the *Physical Knaves* in the Town to be Death's Journeymen. Thus do they License, what they ought carefully to Suppress; and Practice themselves, what they Blame and Condemn in others.''

Of course the Royal College of Physicians did not deign to notice Ned Ward and conservative Doctor Lister would have been the last to admit that there was a grain of truth in Ward's writings. Were he alive today, it is doubtful if he would approve, even as an antiquarian, the use of Ward's statements to indicate London medical manners at the end of the seventeenth century.

At this time Lister was a successful physician of the *beau monde,* critical of the work of Ruysch and Sydenham and preferring the older views. In 1709 he was appointed second physician in ordinary to Queen Anne and before this he had been one of the fourteen doctors who officiated at the last illness of King Charles II, during which the poor man was bled, blistered and scarified and subjected to emetics, purgatives and clysters. Elias Ashmole in his ''Diary'' records first seeing Doctor Lister at a dinner at the home of the Archbishop of Canterbury on September 23, 1683, and more than a year later or on December 19, 1684, the entry reads, ''Dr. Chamberlain proposed to me to bring Dr. Lister to my wife, that he might undertake her,'' and on December 22, 1684, ''They both came to my house and Dr. Lister did undertake her.''

Lister was born about 1638, the son of Sir Martin Lister. Entering St. John's College, Cambridge, in 1655, he graduated B.A. in 1658–9, and M.A. in 1662. It is supposed that Ray, who taught at Cambridge at this time, was instrumental in interesting Lister in natural history. He was quite friendly with Ray,

traveling through France with him on his way to Montpellier to study medicine and writing numerous letters to him, dealing with observations on shells, plants and spiders.

In 1670, he was settled at York, practicing medicine, and in the same year he became a fellow of the Royal Society. The study of natural history and Yorkshire antiquities occupied his spare time, and the Ashmolean Museum later benefited by this, when he presented it with his collection of shells, original drawings, and Roman antiquities found in England. His forty some contributions to the *Philosophical Transactions* cover meteorology, medicine, molluscs, insects and antiquities. Besides, to mention only part of his activities, he translated ''J. Goedartius of Insects,'' added notes and printed it at his own expense in 1682; he wrote ''Historia Animalium Angliæ'' (London, 1678–81), ''Exercitationes octo Medicinales'' (London, 1679), ''A Journey to Paris in 1698'' (London, 1698) and printed an annotated edition of ''De Opsoniis et Condimentis, sive Arte Coquinaria'' in 1705. His most important work, however, was ''Historia sive Synopsis Methodica Conchyliorum'' (London, 1685–92), three volumes, with figures of all the shells then known, made by his daughters Mary and Susannah.

Lister, although somewhat of a speculatist, made many accurate observations in natural history. He did not believe with Goedart that ''an animal may be generated of a fat juice,'' and held to ''animal parents'' as the true cause. He observed the habits of gossamer spiders, the blistering effects of caterpillar hairs, etc. His range of observations is indicated by the following titles from the *Philosophical Transactions,* 1670 to 1684.

Vol. 5, No. 68, p. 2067.

''Extract of a Letter written by Mr. Martin Lister to the Publisher, Januar. 25, $16\frac{70}{71}$, relating partly to the same Argument with that of the former Letter, and directing to another Insect, that is like to yield an Acid liquor; partly to the Bleeding of the Sycamore.''

Vol. 6, No. 71, pp. 2165–2166.

''An Observation concerning certain Insect husks of the Kermes kind communicated by Mr. Lister, May 22, 1671. which came to hand since the Printing of the former sheets.''

Vol. 6, No. 72, pp. 2170–2171.

"A Letter written to the Publisher from York, Jan. 10, 1670, concerning a kind of Fly that is Viviparous, together with a Set of 'curious Inquiries about Spiders,' and a Table of the several sorts of them to be found in England, amounting to at least 33. By Mr. Martyn Lister."

Vol. 6, No. 72, pp. 2176–2177.

"An Extract of a Letter from the same hand, May 30, 1671; concerning an Insect feeding upon Henbain, the horrid smell of which is in that creature so qualified thereby, as to become in some measure Aromatical; together with the colour yielded by the Eggs of the same, &c."

Vol. 6, No. 73, pp. 2196–2197.

This refers to a "kind of Insect, hatched of the English Kermes," formerly noticed and described in No. 71, p. 2164.

Vol. 6, No. 75, pp. 2254–2257.

"A Considerable Accompt touching Vegetable Excrenscencies, given by that Learned and Observing Gentleman, Mr. Martin Lister, in a Letter to the Publisher, of July 17, 1671, from York."

Vol. 6, No. 76, pp. 2284–2285.

"Another Letter, written of the same Gentleman, from York Sept. 13. 1671. enlarging his former Communications in Numb. 75. about Vegetable Excrescencies, and Ichneumon-Worms."

Vol. 6, No. 77, pp. 3002–3005.

"Some Additions of Mr. Lyster to his former Communications about Vegetable Excrescencies, and Ichneumon Wasps; together with an Inquiry concerning Tarantula's, and a Discovery of another Musk-sented Insect; transmitted to the Publisher from York in two letters, of Octob. 16. and 28. 1671."

Vol. 6, No. 76, pp. 2281–2282.

"A Letter of Mr. Martin Lister, written at York August 25, 1671. confirming the Observation in No. 74. about Musk sented Insects; adding some notes upon D. Swammerdam's book of Insects, and on that of M. Steno concerning Petrify'd Shells."

Vol. 7, No. 87, pp. 5059–5060.

"An Extract of a Letter of Mr. Lister to the Publisher, both enlarging and correcting his former Notes about Kermes; and withal insinuating his conjecture of Cochineil's being a sort of Kermes."

Vol. 14, No. 160, pp. 592–596.

"A Letter formerly written to Mr. H. O. containing the Projection of the Threds of Spiders, and Bees breeding in cases made of Leaves, as also, a Viviparous Fly, &c. by Dr. M. Lister."

After Lister moved to London in 1684, his professional duties occupied his time to the exclusion of natural history. In that year he was created M.D. by the University of Oxford. In 1687, he was elected a fellow of the Royal College of Physicians and in 1694, a censor. His "Journey to Paris" was the result of his attachment in 1698 to the Earl of Portland's embassy to the French court. He remained only six months, but during that time made notes on everything he saw, and upon his return to London, these were published. In this account Lister is not concerned with reporting affairs of state, court ceremonies and the like, but devotes himself, in more or less detail, to descriptions of the houses, pavements, gardens, coaches, inhabitants of the streets, the diet of the Parisians, street lights, statues, paintings, contents of museums, collections of private individuals, dissecting rooms, operations, early manuscripts, medals, books, the king's library, libraries of various convents, pottery, vegetables, wines, water, the operas, comedies, gambling, knavery, plants, flowers, trees, the air of Paris, quarries, the diseases of the people, the apothecaries' shops and the tendency of barbers, women, apothecaries and monks to try their hand at curing the pox. Paris of course was well known to Londoners, and Lister's attention to trivial details induced Dr. William King to ridicule it in the "Journey to London." This circulated as a chap-book (probably an abbreviated account) under the title "A journey to London in the year 1698; after the ingenious method of that made by Dr. Martin Lyster to Paris in the same year, &c. Written originally in French by Monsieur Sorbiere and newly trans-

lated into English," (London, 1699). Doctor Lister died at Epsom on February 2, 1712.

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London Retrospective Review, Vol. XIII, pp. 95–109, 1826.

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EURYMUS EURYTHEME F. AMPHIDUSA F. ♀ PALLIDA COCKERELL

One fresh specimen of this form, together with a number of typical *amphidusa* Boisduval (males and females) were captured by Mr. L. A. Tomka and the writer on October 6, 1927, at Dyker Heights, Brooklyn, New York.

A second fresh specimen of *pallida* and three females of *amphidusa* were captured by the writer on August 24, 1928, at Long Beach, Long Island, New York. All four individuals were apparently ovipositing on red clover.

The form *pallida* Cockerell has not appeared in any of our local lists, or in either the New York or New Jersey State lists.—Frank E. Watson.

UNDESCRIBED SPECIES OF ERIOPTERINE CRANE-FLIES FROM THE UNITED STATES AND CANADA (TIPULIDÆ, DIPTERA), PART I[1]

By CHARLES P. ALEXANDER
AMHERST, MASSACHUSETTS

The great tribe of Eriopterine Tipulidæ is well developed in the Nearctic fauna and many species remain to be described, especially in the larger and more involved genera. The species discussed at this time were mostly collected by Professor J. Speed Rogers and the writer in the Eastern United States, a few additional forms being from Canada and the Western States, where they were collected by Messrs. Bryant, Crampton, Criddle and Van Duzee. I wish to express my thanks to all of the above named entomologists for this kind coöperation in making known this interesting fauna. Except where stated to the contrary, the types of the novelties are preserved in my collection.

Genus *Erioptera* Meigen

Erioptera (Erioptera) bryantiana new species.

Size large (wing, ♀, over 7 mm.); general coloration sulphur-yellow, the praescutum and scutum with reddish markings; postnotal mediotergite yellow, the posterior half with two confluent reddish brown areas; halteres and legs yellow; wings fulvous-yellow; ovipositor with the tergal valves strongly upcurved, their margins smooth.

Female. Length about 6.5 mm.; wing 7.2–7.4 mm.

Rostrum and palpi yellow. Antennæ yellow, the outer flagellar segments passing into dark brown. Head pale whitish gray, the center of the vertex vaguely darkened; posterior orbits narrowly yellow; eyes (female) relatively large, contiguous beneath.

Pronotum pale yellow. Mesonotal praescutum chiefly covered by four dull reddish stripes, the lateral margins yellow; tuberculate pits and pseudosutural foveæ pale reddish; scutum yellowish medially, the center of the lobes infuscated; scutellum light yellow; postnotal mediotergite yellow, the posterior half with two confluent oval reddish brown areas. Pleura sul-

[1] Contribution from the Department of Entomology, Massachusetts Agricultural College.

phur yellow, the anepisternum and ventral sternopleurite somewhat more reddish to produce a faint longitudinal striping. Halteres pale yellow. Legs with the coxæ and trochanters pale reddish yellow; legs yellow, the terminal tarsal segments dark brown. Wings with a very strong fulvous yellow suffusion, the base more saturated; stigmal region vaguely darkened; veins dark yellow. Venation: *Rs* long; vein *2nd A* very strongly sinuous. Abdomen obscure yellow, the tergites narrowly darkened laterally. Ovipositor with the valves yellow, the tergal valves strongly upcurved, the margins smooth.

Habitat.—Alberta.

Holotype, ♀, Bilby, June 19, 1924 (Owen Bryant).

Paratopotype, ♀, June 8, 1924 (Owen Bryant); returned to Mr. Bryant.

Erioptera bryantiana is named in honor of the collector, Mr. Owen Bryant. Although still known only from the female sex, the species appears to be very distinct from all known Nearctic species of the subgenus. The conditions under which this cranefly were taken have been discussed in another paper on the craneflies of Alberta (Can. Ent., 59: 214–215; 1927).

Erioptera (Erioptera) chrysocomoides new species.

Male. Length about 3.8–4.2 mm.; wing 4.5–5 mm.

Female. Length about 4.5 mm.; wing 4.5–5 mm.

Generally similar to *E.* (*E.*) *chrysocoma* Osten Sacken, differing especially in the structure of the male hypopygium.

Antennal scape dark, the flagellum chiefly brownish yellow. Mesonotum pale reddish brown, with scarcely evident darker markings. Halteres chiefly pale, the base of the stem darkened. Legs with the coxæ and trochanters pale; fore femora chiefly black, the bases narrowly yellow; posterior femora yellow, only the extreme tips darkened; tibiæ dark brown; tarsi brown, the fore tarsi somewhat paler; segements of legs with long conspicuous erect setae. Wings pale yellow, the apical suffusion tending to be much more extensive than in *chrysocoma*, usually involving at least the outer ends of all radial cells beyond the cord; the small dark brown dots arranged about as in *chrysocoma*. Venation: Tip of Sc_1 beyond R_2; Sc_2 about opposite one-third the length of *Rs;* Anal veins more strongly divergent, vein *2nd A* usually short and nearly straight. Abdomen brownish yellow, the hypopygium still brighter. Male hypopygium large, the structure about as in *chrysocoma* but the details quite distinct. Outer dististyle with the outer arm more dilated. Gonapophyses with the lateral subtending arms much stouter and paler. Basal gonapophyses very different in structure, stout, the apex abruptly narrowed into a black spine, this latter surrounded by numerous setae.

Habitat.—Tennessee.

Holotype, ♂, Allardt, Fentress Co., altitude 1650 feet, July 8, 1924 (J. S. Rogers); Coll. No. 82.

Allotopotype, ♀, July 15, 1924 (J. S. Rogers); Coll. No. 9.

Paratopotypes, several ♂, ♀, June 16–July 15, 1924.

Type returned to Professor Rogers.

The chief characters for the separation of the present species from *chrysocoma* lie in the more divergent anal veins and the structure of the basal gonapophyses of the male hypopygium.

Erioptera (Erioptera) subfurcifer new species.

Male. Length about 4.5 mm.; wing 5.5 mm.

Belongs to the *chlorophylla* group; most closely allied to *E.* (*E.*) *furcifer* Alexander, differing especially in the structure of the male hypopygium.

Male hypopygium with the outer dististyle broadly flattened, the apex darkened, the outer apical angle further produced into a point, the outer margin of the blade microscopically serrulate. Inner dististyle slender, profoundly bifid at apex, as in *furcifer*, the outer arm terminating in a smooth, slender, darkened spine, the inner arm entirely pale, more flattened; outer margin of fork of the style with microscopic setulæ. Gonapophyses appearing as broadly flattened dark-colored plates, the outer apical angle produced into a spine, the margins of the plate with numerous microscopic denticles, more abundant and arranged multi-serially along the lateral edge.

E. furcifer has the outer dististyle unusually slender, the apex blackened, truncate and entirely smooth. Inner dististyle with the outer arm more erect, conspicuously hairy. Gonapophyses slender, pale, the apex and outer margin with small weak denticles, the apophyses not at all produced into a spine.

Habitat.—Michigan.

Holotype, ♂, Washtenaw Co., June, 1920 (J. S. Rogers); Coll. No. 126.

Type returned to Professor Rogers.

Erioptera (Ilisia) manitobensis new species.

Male. Length about 4 mm.; wing 5 × 1.25 mm.

Allied to *E. cinctipennis* Alexander, differing chiefly in the coloration, venation and details of coloration.

Head gray. Antennæ black throughout. Anterior lateral pretergites conspicuously light yellow. Mesonotal praescutum obscure gray, with four brown stripes; tuberculate pits widely separated, small; pseudosutural foveæ conspicuously blackened; interspaces obscure yellow; posterior sclerites of mesonotum grayish brown. Pleura clear light gray. Halteres pale yellow.

Legs with the coxæ gray; trochanters brownish yellow; femora dark brown, the bases of all femora broadly yellowish; tibiae pale brown, the tarsi passing into darker. Wings pale yellowish subhyaline, conspicuously cross-banded with brown, including a broad outer band having its proximal edge at the cord; a more diffuse inner band at the level of the origin of *Rs*, the two areas connected in cells *Cu* and M_4; the pale ground-color before and beyond the outer band much broader and more conspicuous than in *cinctipennis*. Venation: *m-cu* nearly its own length before the fork of *M;* Anal veins divergent, vein *2nd A* being short and nearly straight. Abdomen dark brown, with conspicuous short yellow setae. Male hypopygium much as in *cinctipennis,* the inner dististyle with a series of conspicuous black spines along the margin, the outer spine largest, these gradually decreasing in size basally. Outer dististyle slender, the tip obtuse. Gonapophyses relatively wide, the tips obtuse, the margins smooth.

Habitat.—Manitoba.

Holotype, ♂, Aweme, June 24, 1924 (N. Criddle).

Type in the Canadian National Collection.

The strongly patterned wings, with divergent anal veins, and the wide gonapophyses of the male hypopygium offer the chief characters for the separation of the present species from *cinctipennis.*

I am referring the present group of Eriopterine crane-flies to the subgenus *Ilisia,* but with considerable doubt. The relationship to the European *E. melampodia* Loew seems certain and this latter species has been placed in *Ilisia* by Continental students. In some respects, the species of the group agree better with *Psiloconopa* Zetterstedt. There is a conspicuous difference in the course of the anal veins in the different Nearctic species. In some, as *cinctipennis,* vein *2nd A* is long and somewhat sinuous, agreeing with the same characters in the subgenus *Erioptera;* in still other species that are certainly closely allied (as the present species and *E. painteri* Alexander), vein *2nd A* is short and straight, diverging strongly from *1st A.*

Erioptera (Ilisia) carbonipes new species.

Closely allied to *E.* (*I.*) *cinctipennis* Alexander and formerly confused with this species, differing especially in the entirely black legs and details of structure of the male hypopygium.

Male hypopygium with the inner dististyle very large and flattened, terminating in the usual two points, of which the outer is a blackened spine;

beyond midlength of the outer margin of the blade a conspicuous tubercle bearing a small delicate seta; posterior portion of margin of style with small acute teeth. Gonapophyses unusually wide, appearing as broad flattened plates, the tips obtuse but microscopically denticulate.

In *cinctipennis* the legs are pale, especially the bases of the femora. Male hypopygium with the inner dististyle narrower, the outer margin with large conspicuous teeth. Gonapophyses unusually narrow, especially on the distal third where there are one or two weak denticles on the lower or cephalic margin.

Habitat.—Washington.

Holotype, ♂, Northbend, King Co., July 10, 1920 (E. P. Van Duzee).

Type in the California Academy of Sciences.

The type of *E. carbonipes* was returned to the California Academy of Sciences with the determination "*E. cinctipennis* Alexander." It is now evident that there are several species of the group in western and northern North America.

Erioptera neomexicana new species.

General coloration light gray; femora obscure yellow, broadly darkened before tips; halteres yellow; wings subhyaline; cell M_2 open by the atrophy of basal section of M_3; abdomen chiefly yellow; male hypopygium with both dististyles terminal in position, the outer style microscopically spinulose at apex, before tip with a conspicuous black spine.

Male. Length about 3.8 mm.; wing 4.3 mm.

Rostrum and palpi brownish yellow, the latter darkened outwardly. Antennæ dark brown, the basal segments and remainder of head obscured by shellac.

Mesonotum light gray, the praescutum with very narrow brown lateral lines; tuberculate pits black, lying just cephalad of the level of the pseudosutural foveæ; scutum gray; scutellum gray, the margin yellowish; postnotal mediotergite gray, the anterolateral angles conspicuously light yellow. Pleura variegated gray and yellow, the latter coloration forming more or less distinct transverse bands on the anepisternum and sternopleurite, and on the pleurotergite. Halteres yellow. Legs with the fore and middle coxæ dark, the posterior coxæ yellow; trochanters brown, the posterior trochanters yellow; femora obscure yellow, darkened outwardly, the extreme tips narrowly pale; tibiæ brownish yellow, the tarsi darker. Wings relatively narrow, subhyaline, the stigmal region vaguely darkened; veins brown. Venation: Sc_1 ending opposite the fork of Rs, Sc_2 far from its tip, just beyond the origin of Rs; Rs long, straight; R_2 a little shorter than R_{2+3+4}, placed just beyond the fork of the latter; cell M_2 open by the

atrophy of basal section of M_3; *m-cu* just before the fork of *M*; vein *2nd A* short, nearly straight, diverging from *1st A*.

Abdomen chiefly yellow, the sternal incisures darker; subterminal segments more or less darkened medially. Male hypopygium with the dististyles terminal in position, both small; outer style pale at base, more than the distal half blackened; outer margin before tip with a long acute black spine; apex of style densely set with small spines to produce a mace-like appearance. Inner dististyle subequal in length, pale, its tip dusky. Gonapophyses appearing as flattened black blades, the margins smooth, the tips acute.

Habitat.—New Mexico.

Holotype, ♂, Jemez Springs, June.

The strict subgeneric position of *E. neomexicana* may be held as somewhat questionable. The fly is quite distinct from all known regional species.

Genus *Psiloconopa* Zetterstedt

Psiloconopa gaspicola new species.

General coloration dark gray; wings brownish yellow, the stigmal region faintly darker; veins stout; vein *2nd A* unusually short and straight; male hypopygium with the outer dististyle broadly dilated; inner dististyle slender, narrowed to the weakly bifid blackened apex.

Male.—Length about 5.5 mm.; wing 5.2 × 1.2 mm.

Described from an alcoholic specimen.

Rostrum, palpi and antennae black; flagellar segments oval, decreasing in size outwardly. Head dark gray.

Thorax dark gray, the anterior lateral pretergites and dorso-pleural membrane paler; pseudosutural foveæ and tuberculate pits black. Halteres pale yellow. Legs with the coxæ and trochanters brownish yellow, the former darker at bases; remainder of legs broken. Wings of moderate width, as shown by the measurements, with a brownish yellow suffusion, the base and costal region more yellowish; stigmal region faintly darker; veins stout, dark brown, those in costal region more yellowish. Venation: As in *P. alaskensis* but with the veins beyond cord shorter and stouter, the forks more shallow; vein *2nd A* unusually short and straight, the cell narrow.

Abdomen dark gray. Male hypopygium almost as in *alaskensis*, the outer dististyle broadly dilated; inner dististyle slender, yellow, the apex blackened and weakly bifid, gently curved to an acute point.

Habitat.—Quebec.

Holotype, alcoholic ♂, Gaspe Peninsula, south shore, June 26–July 1, 1928 (G. C. Crampton).

The discovery of a species of this otherwise essentially arctic and western group of crane-flies in the Gaspe region is of especial interest. A similar distribution in the flora of this non-glaciated portion of eastern Canada is now relatively well-known through the researches of Professor M. L. Fernald and others. *Psiloconopa gaspicola* is closely allied to the Alaskan *P. alaskensis* (Alexander), differing especially in the coloration of the wings and in slight details of venation and structure of the male hypopygium.

Genus *Melophilus* Curtis

Molophilus laricicola new species.

General coloration reddish brown; antennæ (male) of moderate length only, if bent backward extending about to the base of the abdomen; femora yellow, the tips broadly blackened; tarsi black; male hypopygium with the mesal lobe of basistyle set with elongate spines that merge into setae; both dististyles narrow, pale basally.

Male.—Length about 4 mm.; wing 5–5.2 mm., antennae about 2 mm.

Female.—Length about 4.5–5 mm.; wing 5.5–6 mm.

Rostrum and palpi brownish black. Antennæ of moderate length, in male, if bent backward, extending about to the base of the abdomen; scape yellow; flagellum dark brown; flagellar segments elongate, with a dense white pubescence and slightly longer scattered verticils. Head ochreous.

Mesonotum reddish brown, the lateral margin of the praescutum and the pretergites pale yellow; setae of interspaces very small; median region of scutum and base of scutellum medially slightly plumbeous. Pleura reddish yellow. Halteres pale. Legs with the coxæ and trochanters concolorous with the pleura; femora yellow at base, the tips broadly blackened, this most extensive on the fore femora where about the outer fourth is included, least extensive on the posterior femora where only the extreme tips are darkened; tibiæ brown, the tips dark brown; tarsi black. Wings with a yellow tinge, the base and costal region somewhat brighter; veins darker yellow than the ground-color; macrotrichia dark brown. Venation: Vein *2nd A* long and gently sinuous.

Abdominal tergites brown, paler laterally, the sternites more uniformly pale; hypopygium yellow. Male hypopygium with the mesal lobe of basistyle relatively small, the spines unusually long and setiform, those on margin passing into delicate setae; the blackened spines and spinous setae number about fifteen. Both dististyles pale except at tips; outer dististyle nearly glabrous, narrow; inner style narrow, produced into a long, darkened apical point that bears a few scattered setigerous punctures. Aedeagus elongate, in slide mounts extending caudad beyond the level of the other elements of the genitalia.

Habitat.—New York.

Holotype, ♂, Canada Lake, Fulton Co., altitude 1700 feet, June 25, 1928 (C. P. Alexander).

Allotopotype, ♀.

Paratopotypes, 10 ♂ ♀.

Molophilus laricicola is readily told from all other similar species of the *gracilis* group, *pubipennis* subgroup, by the length and structure of the antennæ.

This interesting species occurred in a small sphagnum bog where the forest cover consisted of black spruce, balsam and larch; an abundance of *Ledum, Aronia* and *Viburnum cassinoides;* and the ground cover, besides the dominant sphagnum, included an abundance of pitcher-plants and dwarf smilacina. Bog crane-flies that were associated with this species at this date included *Limonia* (*Dicranomyia*) *profunda* Alexander, *Pseudolimnophila inornata* Osten Sacken, *Limnophila laricicola* Alexander and *Erioptera chrysocoma* Osten Sacken.

Molophilus huron new species.

Male.—Length about 4 mm.; wing 4.8–5 mm.

Female.—Length about 5 mm.; wing about 5.5 mm.

Belongs to the *gracilis* group, *pubipennis* subgroup; closely allied to *M. fultonensis* Alexander, differing especially in the structure of the male hypopygium.

Rostrum and palpi black. Antennæ (♂) elongate, if bent backward extending to about opposite one-fourth the length of the abdomen; flagellum dark brown. Mesonotum reddish brown, the humeral region more yellowish; pretergites pale yellow; remainder of mesonotum reddish brown. Pleura reddish brown to slightly plumbeous. Halteres dusky, the stem yellow. Wings yellow, the vestiture dense, dark brown, including the costal fringe in both sexes. Abdomen dark brown, the hypopygium obscure brownish yellow. Male hypopygium with the spines of the mesal lobe of basistyle very short and stout, peg-like, the coarse marginal setae distinct and not tending to merge into spines. Outer dististyle unusually broad, in general form rectangular, the inner lateral angle produced laterad into a short spine; surface of style with microscopic setulae. Inner dististyle rather broadly expanded, produced in a slender dark spine, this less elongate than in *fultonensis.*

Habitat.—Michigan.

Holotype, ♂, Gogebic Co., August 15, 1920 (J. S. Rogers); Coll. No. 100.

Allotopotype, ♀, August 16, 1920 (J. S. Rogers); Coll. No. 107.
Paratopotypes, several ♂ ♀, July 29–August 16, 1920.
Type returned to Professor Rogers.

Molophilus paludicola new species.

Male.—Length about 3–3.2 mm.; wing 3.5–4 mm.

Female.—Length about 4.5 mm.; wing 4.8–5 mm.

Belongs to the *gracilis* group, *pubipennis* subgroup; allied to *M. fultonensis* Alexander and *M. huron* new species, but much smaller, especially in the male sex, and showing slight differences in the structure of the hypopygium.

Rostrum, palpi and antennal flagellum dark brown; scape obscure yellow; flagellar segments elongate-fusiform, with long, outspreading pale setæ; antennæ (♂) elongate, the segments a little shorter than in *fultonensis*. Head chiefly dark gray, the front and occiput more ochreous.

Posterior pronotum and anterior lateral pretergites pale yellow. Mesonotum and pleura reddish gray, the humeral region of praescutum brighter. Halteres pale, the knobs slightly infuscated. Legs with the coxæ and trochanters yellow, the fore coxæ a little darker; femora testaceous basally, the tips broadly dark brown; tibiæ obscure brownish yellow, the tips narrowly darkened; tarsi dark brown. Wings with a pale brownish suffusion, the base and costal region more yellowish. Macrotrichia of wings dark, including the costal fringe in both sexes, long and conspicuous. Venation: R_2 and *r-m* in alignment; R_{2+3} and R_{4+5} subequal in length; vein *2nd A* relatively short, ending opposite or just beyond the caudal end of *m-cu*.

Abdomen dark brown, the genital segments in both sexes brighter. Male hypopygium with the mesal lobe of basistyle set with unusually small black spines, much smaller than in *pubipennis* and *fultonensis* but quite similar to those of *huron*. Dististyles broadly flattened, the inner lateral angle of each produced strongly laterad into a slender chitinized black point.

Habitat.—Massachusetts.

Holotype, ♂, in boggy meadow near Amherst, altitude 275 feet, July 25, 1928 (C. P. Alexander).

Allotopotype, ♀, pinned with male.

Paratopotypes, 1 ♂, 1 ♀, July 15, 1928 (C. P. Alexander), mounted on same point.

Several of the species of the *pubipennis* subgroup in northeastern North America are becoming increasingly difficult of separation, especially those forms with very elongate antennæ in the male sex and a dark costal fringe in the female. These species are *M. fultonensis* Alexander, *M. huron* new species and

M. paludicola new species. The distinctions between the first two larger species have been given under the description of *huron*. *M. paludicola* is most similar to *huron*, differing in the small size, especially of the male, venation, as the shorter 2nd anal vein, and slight differences in the antennæ and hypopygium.

THE LIST OF OHIO LEAFHOPPERS

Our veteran entomologist, Prof. Herbert Osborn, has just added another important publication to his long list of valuable papers on Cicadellidæ. This one, "The Leafhoppers of Ohio," published in the Ohio State University Bulletin, Vol. XXXII, No. 27, May 31, 1928, is quite characteristic of his previous work, particularly where he is individual author. He has been rather conservative in application of some of the latest taxonomic work and has only applied such where it seemed advisable. His profusion of good text illustrations makes it particularly handy for the non-specialist. An interesting feature is the appended check list of The Ohio Leafhoppers, corresponding to the Van Duzee check list in numeration. As a whole it is a very neat, precise and useful publication. It is just one more block added to the foundation of cicadellid knowledge, just one more volume of useful cicadellid literature and ready reference for the student interested in the distributions of United States Cicadellidæ.—CHRIS E. OLSEN.

SOME FACTS RELATIVE TO THE EFFECT OF HIGH FREQUENCY RADIO WAVES ON INSECT ACTIVITY*

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AND
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NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS

Lutz[1] has indicated that certain high frequency electro-magnetic waves were lethal to a cricket in one instance.

The writers were induced to begin a study of the effects of the gamut of wave lengths (characteristic of radio, infra-red, visible light, ultra-violet, x-ray and radium) by the mounting costs of the chemical control of insects and by the conception that various kinds of living tissue might well exhibit different normal wave lengths. Naturally the problem had to be attacked at some point and that was also naturally determined by apparatus available for producing vibrations. Through the courtesy of the General Electric Company a radio broadcasting apparatus giving a wave length of about 24 meters with a frequency of about 12,000,000 cycles per second was made available. These vibrations were produced through the agency of a 50 watt tube. An ammeter was installed in the line running to one of the terminals. The terminals consisted of two aluminium plates set facing each other. The energy shown on the ammeter could be varied by changing the distance between the terminal plates. The insects and substances experimented with were placed in small glass tubes suspended between the two aluminium plates but not in contact therewith.

The effect of high frequency waves upon the air in the tubes was first determined. The results of this study are set forth in table 1.

* Paper of the Journal Series, New Jersey Agricultural Experiment Stations, Department of Entomology.

[1] Lutz, Frank E., Journal New York Entomological Society. No. 1, Volume 35, page 308, 1927.

TABLE 1

A STUDY OF INCREASE IN HEAT IN DIFFERENT PARTS OF GLASS TUBE USED FOR RESTRAINING HONEY BEES DURING EXPOSURE TO HIGH FREQUENCY

Position of Thermometer	Number of Runs	Av. Amps Used	Increase in Air Temperatures in Degrees F.	Time of Exposure in Minutes
Top quarter	3	1.72	2.8	5
Middle	3	1.74	3.5	5
One inch from bottom.	2	1.725	3.5	5
Bottom	3	1.703	3.0	5
Air between plates	2	1.77	2.5	5

Examination of table 1 serves to show that the increase in temperature in a five minute period does not exceed 3.5 degrees F. This examination also shows that the increase in air temperature between the plates in the absence of the glass tubes does not exceed 2.5 degrees F. Of course it is possible that the temperature recorded on the chemical thermometer is due to heat developed in the instrument and not in the air surrounding it but that contingency does not in any way interfere with the accuracy of the statement made above.

Having determined this factor various insects were introduced into the glass tubes and subjected to high frequency waves until they were dead. The results of this study are set forth in table 2.

TABLE 2

TIME REQUIRED FOR HIGH FREQUENCY WAVES TO PRODUCE DEATH OF CERTAIN INSECTS (ADULTS)

Insects Name	No.	Av. Amps	Av. Time in Minutes to Death	Date of Experiment
Apis millifera	49	1.8	1.28	12/1, 7, 1928
Apis millifera	45	1.78	0.996	12/19, 1928
Glypta	2	1.6	0.24	12/23, 1928
Hymenoptera			1.1	
Musca domestica	71	1.78	1.364	12/14–17, 1928
Diabrotica 12-punctata	12		2.056	10/19, 23, 24, 1928
Pieris rapae	4	1.6	2.08	10/22, 1928
Periplaneta germanica	87		2.23	12/1, 3, 4, 1928

Examination of this table serves to show that adult insects perish with decreasing speed in the following order: Hymenoptera, Diptera, Coleoptera, Lepidoptera, and Orthoptera. This order of difference in the effect of high frequency waves upon insects is interesting because of its apparent correlation with specialization in the morphological structure, especially as regards the nervous system. It would seem that the power of high frequency waves to affect insects varies more or less directly as the specialization of insect structure, particularly the nervous system. Time did not permit a thorough study of larval forms but it is known that much more time is required to kill such larvæ as have been tested than is required to kill adults.

It was observed that immediately after the insects had been killed through the application of high frequency their bodies were hot to touch. It was, therefore, logical that this condition should be investigated in view of the possibility that they might be perishing through the development of lethal high temperatures. The results of this study are set forth in table 3.

TABLE 3

A STUDY OF INTERNAL TEMPERATURES OF HONEY BEES WHEN ALIVE, WHEN RECENTLY KILLED BY HIGH FREQUENCY, AND WHEN KILLED 24 HOURS PREVIOUS TO TREATMENT WITH HIGH FREQUENCY

Number of Specimens Used	Av. Amps Used	Times in Minutes Alive	Internal Temperature Thoracic	Internal Temperature Abdominal	Time of Day When Test was Made
27	....	....	91.05	....	Morning
12	....	....	....	79.4	Morning
Just killed with high frequency					
16	1.78	0.88	124.5	111.2	Morning
26	1.77	1.07	110.1	101.4	Afternoon
Killed with HCN 24 Hours before exposure to high frequency					
15	1.79	1.25	103.3	....	Morning
20	1.73	1.25	101.9	....	Afternoon

Examination of this table serves to show that the normal internal temperature of living honey bees varies from 91.05 degrees F. in the thorax to 79.4 degrees F. in the abdomen. It

also serves to show that immediately after the honey bee is killed with high frequency there exists a temperature in the thorax ranging from 110.1 to 124.5 degrees F. and in the abdomen a temperature ranging from 101.4 degrees F. to 111.2 degrees F. A curious difference appears between morning and afternoon studies. The writers can offer at this time no adequate explanation for this variation. Further examination of this table serves to show that an exposure of dead honey bees to high frequency for a period of one and one-fourth minutes fails to bring their temperature up to that which was obtained in the process of killing honey bees with high frequency.

Reflection upon the fact that high degrees of heat are developed in insects subjected to high frequency, while the air with which they are surrounded remains at a low temperature, indicates pretty definitely that subjection of insects to high frequency results in the development of a high internal temperature.

Reflection upon the facts—that the more highly developed the nervous system is the quicker the lethal heat is developed and that internal temperatures are developed more quickly in the living bee than in the dead bee when subjected to high frequency, lead to the general conclusion that the development of heat in the tissues is decidedly aided by nervous activity.

Naturally the next question is concerned with how this high internal heat is developed. The source of exciting energy is of course the high frequency wave. The tissues of the insect must react to this wave in such a way as to produce heat. To get some information of the reaction of different sorts of tissue to high frequency waves as measured in terms of temperature produced, a study was made of various chemical compounds characteristic of living matter particularly in the animal kingdom and the results are set forth in table 4.

Practically all of the compounds show some increase in temperature when subjected to high frequency waves. Of the sugars and starches glycogen stands out preeminently in that respect. Of the fats and oils cholesterol is revealed as still more powerful. Of the proteins peptone is high. Of the organic chemcal compounds in general, cholesterol is by far the most powerful and this fact is interesting when we realize that cholesterol is very commonly characteristic of nervous matter and activity.

TABLE 4

INCREASE IN HEAT ACCOMPANYING APPLICATION OF HIGH FREQUENCY TO VARIOUS CHEMICAL COMPOUNDS CHARACTERISTIC OF LIVING MATTER, PARTICULARLY IN THE ANIMAL KINGDOM

Compounds	Amps Used	Time of Exposure in Minutes	Increase in Temperature in Degrees F.	No. of runs
Sugars and starch				
Dextrose	1.80	5	71.5	2
Maltose	1.79	5	91.6	3
Levulose	1.80	5	23.12	5
Sucrose	1.82	5	23.25	2
Glycogen	1.80	1	73.0	1
Glycogen	1.80	5	128.0	1
Fats, oils, fatty acids and waxes				
Glycerine	1.80	5	5.5	2
Whale oil	1.775	5	7.6	4
Sperm oil	1.777	5	6.0	4
Linseed oil	1.793	5	10.16	3
Cetyl alcohol	1.795	5	42.75	4
Bees wax	1.800	5	8.5	3
Japan wax	1.835	5	18.5	3
Stearic acid (paste)	1.785	5	36.5	2
Stearic acid (barely wet)	1.78	5	58.6	3
Palmitic acid (barely wet)	1.800	5	67.4	4
Hog lard		5	11.2	2
Cholesterol (barely wet)	1.795	2.5	129.0	4
Cholesterol (dry)	1.800	5	0.0	1
Lecithin (barely wet)	1.800	5	69.5	2
Lecithin (gum like)	1.820	5	34.5	1
Proteins				
Casein (paste)	1.8	5	10.4	4
Casein (barely wet)	1.8	5	46.0	1
Pure protein (barely wet)	1.796	5	76.6	3
Egg albumen (barely wet)	1.8	5	9.0	1
Blood albumen (barely wet)	1.8	5	35.3	3
Harmoglobin (barely wet)	1.8	5	10.0	2
Peptone (barely wet)	1.775	5	113.5	2
Chitin (barely wet)	1.83	5	44.0	3
Charcoal (dry ground)	1.75	5	16.0	2
Charcoal (barely wet)	1.80	3	115.0	2
Charcoal (Allowed to stand two weeks with small amount of water	1.82	5	21.75	2
Silica (barely wet)	1.766	2	132.0	3
Quartz sand (barely wet)	1.80	5	122.5	3

Since carbon is the characteristic material present in organic compounds it was thought worthwhile to study its reaction in relation to high frequency as measured in terms of heat. This study reveals the high heating ability of carbon in the form of charcoal and a study of silica for the purpose of comparison reveals likewise that silica has a high heating reaction.

A study of table 4 serves to show that all the chemical compounds more or less characteristic of living animal tissue with which tests were made show decided increase in heat when subjected to high frequency and that of them all cholesterol stands out preeminently in that respect. It is also interesting to note in this connection that a small amount of water used in connection with these chemicals in a dry form greatly contributes to their heat productive characteristic.

Behind this phenomenon of heat production by living tissue and organic chemical compounds characteristic thereof there is doubtless a definite clear cut physical or physio-chemical explanation but the work of the writers has not proceeded far enough to enable them to see it.

SUMMARY

1. Insects are killed when exposed to high frequency waves of 24 meters and 12,000,000 cycles per second with the ammeter reading about $1\frac{3}{4}$ amperes and this lethal effect is due to the development of an internal heat of lethal degree.

2. Nervous reaction speeds up the rate of producing this internal lethal heat and the more specialized the nervous tissue the greater is the increase in speed of reaction.

3. All organic chemical compounds with which the writers have worked and which are more or less characteristic of living tissue show ability to increase in internal heat when subjected to the above high frequency waves and of all of these organic compounds with which work has been done, cholesterol stands out preeminently in this respect.

4. Cholesterol is characteristic of nervous tissue.

NOTE ON AN IMITATION OF THE DEPORTATION HABIT IN POLYERGUS LUCIDUS MAYR

BY CARYL PARKER HASKINS

It has chanced that in the course of two years' observation of colonies of the Shining Amazon Ant, *Polyergus lucidus* Mayr, principally in the artificial nest, a curious case of imitation has come to light which, as it happened, had never been previously encountered by the author. Undoubtedly the case is a common one, and has perhaps been frequently recorded, but, never having personally encountered such record in the literature I have entered it here in the hope that it may be of some possible interest to those concerned with the ant.

The colonies concerned were taken near New Haven, Conn., in small sunny park-like valley-areas in deep sand loam. In these localities *Formica shaufussi* Mayr forms prosperous and relatively populous colonies, composed of exceptionally large individuals, but not empty of pseudogynes. The nests of the Amazons are therefore abundantly supplied with large and aggressive slaves, and are easily transferrable to modified Lubbock, earth-filled nests. There the ants concerned became satisfactorily established in a very short time.

Long after the excavation of galleries, and other disturbances incident to establishment in a new situation, had subsided, the slaves continued to carry the *lucidus* about the nest from time to time. The mistresses, evidently considering the operation quite a usual one, submitted to the treatment without protest and, remaining inert, were handled after the usual fashion of *schaufussi* in deporting its own species. The *lucidus,* in characteristic fashion, idled about the nest showing no interest in its construction or in the care of the brood and confining themselves to laying numerous eggs, and occasionally to devouring them.

Within three weeks however the mistresses, no longer occupied by any prospect of a foray, began to pass the leisure hours in a crude imitation of the deporting habits of the slaves. Frequently *lucidus* workers seized one another and attempted to

carry or to drag the burden with occasional success. This deportation was of a markedly different character from the clean-cut operation of the slaves. The deported individual was seized at random by any portion of the body and aimlessly dragged about, though with no evidence of hostility, meanwhile vigorously resisting the will of its captor. The action closely resembled the deportation habits of such primitive Ponerinæ as *Stigmatomma pallipes.*

The *lucidus* shortly transferred their attentions to the slaves, seizing them by a leg or an antenna and dragging them about. The latter were thoroughly surprised and alarmed at this conduct and occasionally actively resented the action of the parasites.

Within a month however I was extremely surprised to observe the slaves practicing the identical method of deportation upon the *Polyergus,* and among themselves. The practice was an exact copy of the actions of the *lucidus* and was kept entirely distinct from the usual method, which continued to be employed for some time.

The necessarily abnormal conditions of the artificial nest, coupled with the complete stultification of the slave-foray, accounts perhaps for these activities. Under normal conditions the *lucidus* workers doubtless never attempt to deport one another, or their slaves. But the acquisition by the slaves of an imperfect and, to all appearances, primitive habit, taken up in faithful imitation of a trick apparently either surviving feebly from the time of the hypothetical independence of the obligatory slavemakers, or more probably reacquired in turn by imitation of the much more highly specialized normal habits of deportation of *schaufussi* has struck the author. He has wondered whether it may be of any slight significance, in view of Kutter's remarkable discovery that the slaves of *Strongylognathus alpinus* have completely imitated the mistresses in a much larger matter, the action of the slave foray, that they have become adept in the art, compose a goodly percentage of the foray column, and render indispensable assistance to the *alpinus* in their nocturnal raids on *Tetramorium caespitum.*

NOTES ON THE LIFE HISTORY AND HABITS OF THE BLUEBERRY STEM BORER, OBEREA MYOPS HALD., ON CULTIVATED BLUEBERRIES[1]

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While working on cranberry and blueberry problems at Whitesbog, N. J., from 1923 to 1927, the writer had an opportunity to take notes on the habits and life history of a coleopterous larva found boring in stems and branches of the cultivated blueberry. Diligent search failed to locate a specimen of the adult beetle in the field. It was not until the summer of 1927 that the writer was able to rear an adult from collected larval material and have it identified. Mr. W. S. Fisher, of the Bureau of Entomology, U. S. Department of Agriculture, identified the beetle as *Oberea myops* Hald. There has been little information published on the life history and habits of this species except when included as a variety under *O. tripunctata* Swed. For this reason the notes of the writer on the life history and habits of this species, although incomplete, are brought together at this time.

PREVIOUS HISTORY

The history of *Oberea myops* Hald. is not easily traced in the literature due to the fact that it has been included as one of several varieties of *O. tripunctata* Swed. Blatchley (1), in his description of *O. tripunctata* Swed., mentions *myops* as a color variety of this species. He mentions cottonwood and blackberry as hosts. Britton (2) records *O. tripunctata* var. *myops* Hald., as breeding in *Oxydendrum arboreum* and azalea in Connecticut. Jones (4) reports *O. tripunctata* Swed., as breeding in raspberry and blackberry canes in Wisconsin. Leonard (5), in a reference

[1] Paper of the Journal Series of the New Jersey Agricultural Experiment Stations, Department of Entomology.

to *O. tripunctata,* says: "The varieties *myops* Hald., and *mandarina* Fab., are not differentiated in the records (Lg)." He lists the larva as feeding on plum, apple, quince, peach, elm and dogwood. Felt (3) provisionally identified injured azalea twigs sent in from Rochester, N. Y., as the work of the dogwood twig borer, *O. tripunctata* Swed. One borer, presumably the same, was also found in rhododendron. Weiss (6) records the dogwood twig girdler, *O. tripunctata* var. *myops* Hald., as having been collected at several localities in New Jersey. In a memorandum sent to the writer, Mr. W. S. Fisher, of the Bureau of Entomology, has this to say: "I found *myops* very abundant at Lyme, Conn., during 1918, and the larvæ were boring in the mountain laurel. In that locality it was a two year species." In recent correspondence with the writer Dr. Britton states that *myops* has been bred from azalea a number of times in and around New Haven, Conn.

Nature of Injury on Blueberry

Two types of injury are produced by *Oberea myops* Hald., on blueberry. In late June and in July the first three or four inches of the current seasons growth may be found wilted or dead. Such an injury may be found on large, rapidly growing suckers or on smaller, slower growing twigs. If an injured twig is examined one will find the shoot or twig girdled in two places about one half inch apart. This type of injury is caused by the adult beetles when depositing eggs. Another type of injury that may be noted is the dying out of the canes. The leaves first turn from a green to a yellow or reddish color and drop off, followed by the dying out of the cane. Closer examination will show holes about the size of an ordinary pin head located at intervals of three or four inches along the shoot, and hanging from these, yellowish strings of castings may be found. A small pile of these castings is often found at the base of the cane. If the cane is split a cylindrical tunnel extending down the center of the cane, or just under the bark, is found. At the bottom of the tunnel a yellowish, legless grub from one half inch to an inch or more in length may be found. A small plant may be entirely killed by the tunneling of a larva. In this case the tunnels will be found

to extend up the several branches of the plant and down into the roots.

METHOD OF REARING AND LENGTH OF LIFE CYCLE

The method of rearing the larvæ was as follows: The twigs containing the larvæ were cut below the lowest point reached by the larvæ in tunneling. The end of the twig was then cleft grafted to a fresh twig and the two bound with muslin (Plate V, Figs. 1 and 2). No difficulty was experienced in getting the larvæ to bore from the old to the new twig. Figure 4 of Plate V shows an old twig from which a larva has tunneled. Figure 3 of the same plate shows the new twig split to show the new tunnel with the larva inside.

A number of larvæ was collected in the field in the summer of 1925. These larvæ were about one half inch in length, which indicated that they were at least one year old. These larvæ continued tunneling from one grafted stem to another throughout the latter part of the summer of 1925 and all of the summer of 1926. Out of the lot collected in the summer of 1925, four survived to, and pupated in, the spring of 1927. Of the four pupæ, one had emerged from the pupal skin inside the tunnel on May 23, 1927; another changed to an adult on June 3, 1927; a third had emerged and was boring out of the tunnel on June 19. The fourth pupa was lost.

A second lot of larvæ measuring from one half to three fourths of an inch in length was collected in the summer of 1926. The size of these larvæ at the time they were collected indicated that they were at least one, and possibly two, years old. Four of the larvæ, reared on grafted twigs, survived until the spring of 1927. Three of the larvæ changed to pupæ and emerged in May and June, 1927. The fourth larva continued boring actively up into June, at which time observations were discontinued.

Unfortunately, time and circumstances did not permit the writer to trace the life cycle of this insect from egg to adult in any one specimen. To that extent the life cycle is not complete. However, the rearing records for the larvæ collected in 1925 and 1926, together with their size when collected, indicate that this species requires three years to complete its life cycle in blueberry

under the conditions of rearing that were employed. Were the larvæ to remain undisturbed on the plant in the field throughout their life cycle, it may be possible for some of them to complete their life cycle in two years.

Description and Seasonal History

The Adult

The adults (Plate V, Figs. 7 and 8) are elongated, slender beetles averaging one-half inch in length. The under part of the body is yellow with black markings. The head is yellow, with the eyes and antennæ black or dark brown. The thorax is yellow with two small, round black spots on the disc. There are two additional black spots, one on each side of the thorax, situated at a point between and above the first and second pairs of legs. The elytra are grayish yellow, coarsely and deeply punctured, sometimes with a narrow, slightly dark stripe on the inner edge and a wider dark stripe on the outer edge. The yellow color of the beetle may vary from light to dark.

The adults are on the wing in June, July, and August. One beetle that was reared from larval material collected in the field was found to have shed its pupal skin by May 23 but had not begun to bore its way out. On June 19 three more beetles from reared material had shed their pupal skins and were boring their way out. Girdled twigs in which the eggs are deposited begin to appear in June and continue during July and early August. The peak of the egg laying season is the last week in June and the first week in July. The beetles apparently girdle twigs at night. Diligent search failed to find any beetles at work or on the wing in the day time.

The Eggs

The yellowish, cylindrical and slightly curved eggs (Plate V, Fig 9) are 3 to 4 mm. long and about 0.5 mm. in diameter. The egg shell is tough but soft, allowing the egg to be flattened without apparent injury. Before depositing the egg, the adult makes two girdles, or rings of punctures, about one half inch apart and from three to six inches from the tip of the shoot.

The bark between the girdles is then slit lengthwise of the stem and the egg placed under one of the flaps of bark. That part of the twig above the two girdles immediately wilts and dies. When the dead tip becomes dry and brittle it usually, though not always, breaks off at the upper girdle. Growth of the section between the two girdles is arrested by the lower girdle. This section remains partly green for some time, usually until the egg hatches, after which the girdled tip dies (Plate V, tip of Fig. 5). No exact records on the time of incubation of the eggs was obtained. Field observations indicate that the incubation period is from ten days to two weeks.

THE LARVA

The newly hatched larva bores into the dead or dying half inch of stem between the two girdles. The larva continues boring to the tip of the twig and if that part of the twig beyond the upper girdle is intact may bore into it for a short distance. The larva then reverses itself and begins boring down the live part of the stem below the lower girdle. If a side twig is encountered (Plate V, short twig on left of Fig. 5) the larva may bore up this to the tip whereupon it reverses itself, plugs with castings the tunnel up the side twig, and continues down the main stem. At regular intervals tiny, circular orifices are bored to the outside of the stem through which the castings are ejected. When cold weather sets in the young larva plugs the tunnel with frass a short distance above the lowest point reached in tunneling. Another plug of frass is placed above this and the larva passes the winter between the two plugs, with its head pointed up the stem. The distance tunneled by the young larva after hatching and up to the time it constructs its winter "cell" varies from one or two to several inches, the distance tunneled depending on the time of hatching. The size of the young larvæ overwintering varies from one eighth to a little over one fourth of an inch (Plate V, Figs. 5 and 6).

Early the following spring the young larva starts tunneling down the stem. By the middle of the summer the yellow, legless but active larva has reached a length of one half inch or more. The distance a larva will tunnel by the end of the second sum-

mer was not determined. However, observations made on the activity of the larva in grafted twigs indicate that the larvæ reach the base of the bush by the end of the second summer. As the larva grows the circular openings it bores to the outside to dispose of castings increase in diameter (Plate V, Fig. 4, see arrow). Those larvæ reared in grafted twigs blocked off the tunnel with two plugs of frass when cold weather approached and passed the second winter upright in the cell thus formed.

The habits of the larvæ (based on observations made on larvæ one half inch long, collected in August, 1925, and which emerged as adults in June, 1927) during the third summer and winter are about the same as their habits the second summer and winter. At the end of the third summer the larvæ reach a length of one to one and a fourth inches (Plate V, Fig. 3). The following spring the larvæ remain in "cells" with heads pointing up the stem. In March the larvæ are to be found inactive with the body shortened and thickened.

The Pupa

The shortened, thick and inactive larvæ changes to pupæ in April or May. In the mature pupæ the appendages of the adult that is to emerge may be plainly seen. When ready to emerge the adult works out of the pupal skin (Plate V, Fig. 7) and chews its way to the outside.

Control

Only one parasitic enemy of *Oberea myops* Hald., was observed. This was a small hymenopterous parasite, the identity of which was not determined. Out of ten recently hatched larvæ collected the middle of July, 1925, five were found to be parasitized. This was the only time the writer reared parasites from any of the stages in the life cycle of the Blueberry Stem Borer.

A practical control for this insect, and one which is generally followed in cultivated plantings, consists in cutting out infested shoots at a point below the egg or larva. Such prunings may be left on the ground as the larvæ are unable to crawl back to the plant. In June, July and August the wilted or dry and brown dead twigs resulting from the egg laying of the beetles may be

readily seen. If the berry pickers are instructed to destroy all such wilted or dead twigs a considerable reduction in the number of larvæ will be made, and this at a time when the injury to the plant is negligible.

A number of larvæ that escaped destruction in the egg or young larval stage may be pruned out in the regular pruning season. Occasionally a shoot will be pruned out through which the larvæ has already passed to the crown of the plant. A piece of bailing wire worked down into such burrows will account for many of the larvæ. The control measures outlined should be carried out every year because new infestations may be expected from beetles bred in wild blueberry and other closely related plants.

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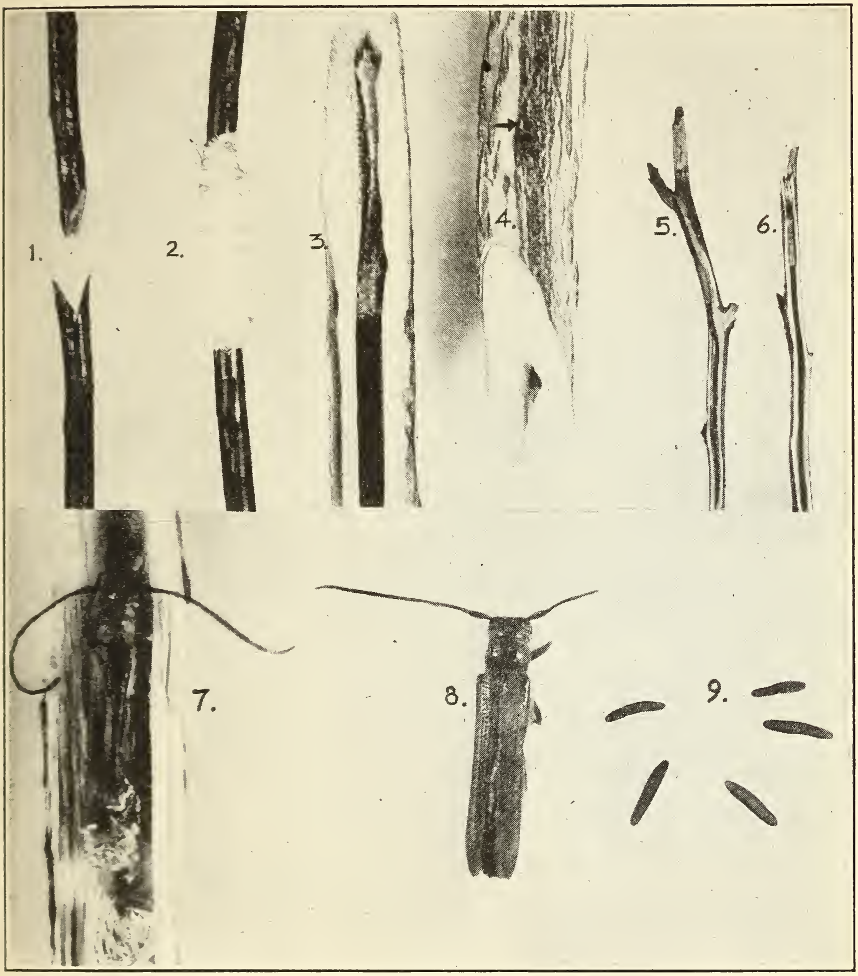
PLATE V

1. Method of grafting stem containing larva of Blueberry Stem Borer to new stem.
2. Completed graft bound with muslin.
3. New graft showing nearly mature larva in tunnel. About $1\frac{1}{4} \times$ natural length.
4. Old shoot from which larva has tunneled; arrow points to exit hole through which castings are ejected.
5. Twig with young larva in tunnel; light colored tip of stem shows section between girdles where egg was deposited. About natural size.
6. Twig with young larva in tunnel; note frass plug above larva. About natural size.
7. Adult emerging from pupal skin inside tunnel; note large plug of frass below beetle. About $3 \times$ natural length.
8. Adult beetle. About $3 \times$ natural length.
9. Eggs of the Blueberry Stem Borer. About $2 \times$ natural length.



OBEREA MYOPS

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

MEETING OF MAY 15, 1928

A regular meeting of the New York Entomological Society was held at 8 P. M., on May 15, 1928, in the American Museum of Natural History; President Henry Bird in the chair with fourteen members and five visitors present.

The Executive Committee submitted the following report and recommendation: In the matter of the entertainment of the visiting entomologists, on their way through New York to the Entomological Congress at Ithaca, next August, the Executive Committee recommends the following plan: That a committee of one be appointed from our Society who will act with one from the Brooklyn Society and who shall have power to name two more additional members in meeting the foreigners and arranging the details for the several days when the visitors will be with us. Their entertainment will consist of a bus ride, which will be a feature consuming one day; the following day a visit to the Brooklyn Museum, to Staten Island, and perhaps to other points; further that a joint meeting of both Societies to be held August 10, in the evening, when opportunity will be fully offered to all to meet the various visitors.

The committee recommends further that the chair be empowered to appoint such a special committee head and that a sum not to exceed $75 be voted from the funds of the Society to meet the necessary expenses.

Dr. Lutz supplemented the report by outlining the plans as formulated and including the coöperation of Brooklyn Entomological Society, Boyce Thompson Institute and Staten Island Museum.

On motion by Mr. Angell the recommendations of the Executive Committee were adopted.

The president in accordance therewith appointed Dr. Lutz as the Society's committee with power to select two others.

The following newspaper item was read.

WATER PLANT AND BORAX AID WAR AGAINST MOSQUITO

Inexpensive Larvicide Can Be Made of Growth, But Reason Is Undiscovered

ITHACA, May 9 (AP).—Two simple weapons for the warfare against mosquitoes have been evolved at the New York State College of Agriculture at Cornell University.

Experiments conducted by Robert Matheson, professor of entomology, and E. H. Hinman, his assistant, have demon-

> strated that a familiar water plant is anathema to the larvaæ of the insects and that ordinary borax, placed in rain barrels, water tanks and other breeding places, is an effective and inexpensive larvicide.
>
> The plant, known as chara fragilis, is closely related to the algæ commonly found in fresh water pools. Just why it kills "wrigglers" has not yet been determined, but the experiments suggest that chemical agents released by the growing plant are responsible.
>
> Cornell entomologists observed several years ago that natural pools containing excessive growth of chara fragilis harbored no mosquito larvæ, although near-by pools, in which the chara was not present, were nurseries for the immature insects. A long series of experiments, recently concluded, showed that the plant was fatal to the larvaæ of at least four mosquito species. The mortality rate was 96 per cent. Furthermore, it was found that the introduction of small quantities of dried chara fragilis to aquaria also had a lethal effect on the wrigglers.
>
> While experimenting with the plant the entomologists discovered that borax would not only kill the larvæ but that two ounces of the crystaline salt to ten gallons of water would prevent all mosquito breeding.
>
> Professor Matheson and Mr. Hinman, with financial assistance from the research fund established at Cornell by August Heckscher, of New York, plan to renew their experiments during the coming season in the hope that much can be learned about the introduction, cultivation and utilization of chara fragilis in mosquito control.

Mr. Bird spoke of Azolla having been found useful also in checking mosquito larvæ. He also referred to a recent paper by Dr. Stiles in Science.

Mr. Engelhardt spoke of his recent visit to Texas and neighboring states during which he had accompanied Mr. Glick in aeroplane studies of insects at elevations of 50 to 5000 feet. The changes in the vicinity of Brownsville, the caves and their subterranean life in the limestone belt near Austin and San Marcos, and the agricultural wealth of the State were among the subjects of general interest on which he touched.

Entomologically the great collection of parasitic Diptera at Dallas and the Snow collection at Lawrence were features of interest. On his return he visited at Cincinnati the admirably prepared collection of Micro-Lepidoptera of Miss Annette Braun and at Washington accompanied by Messrs. Barber and Busck, Dr. E. A. Schwarz on an auto trip during which the octogenarian entomologist personally collected beetles.

Mr. Schaeffer spoke of the recent accession of the Weeks collection to the Brooklyn Museum and the additions to the New York State List that would eventually result therefrom. As examples of the character of the collection he instanced six boxes of *Calosoma scrutator* and twenty-six specimens of *Goes tigrina*. Its value was enhanced by being generally in good condition and containing, amid its bulk, many individual specimens establishing records.

Passing to his recent studies in Chrysomelidæ, Mr. Schaeffer gave several instances of taxonomic changes that would be necessary; all of which will be published as soon as possible.

Miss Dobroschky exhibited the fly *Ornithopenus americanus* (?) from the wing of a hawk on which Messrs. Curren and Bromley made comment.

Mr. B. F. Hyde, present as a visitor, spoke briefly of his recent sanitary seclusion.

Mr. Angell exhibited several interesting beetles.

Mr. Lemmer spoke of his spring collecting at Lakehurst, disappointing on account of the cold weather, but yielding one species not previously found.

Mr. Davis exhibited most of the cicadas referred to in his recent papers published in the Journal of the Society, December, 1927, and March, 1928, stating that it was of interest how the different species from a given area often closely resemble one another. He instanced *Okanagana schaefferi, O. gibbera* and *O. fratercula,* native of Utah, as an example. In the *Borencona aguadilla* from Porto Rico he pointed out that the inward slant of the first cross vein was most unusual. But two species of cicadas are definitely known from Porto Rico, but probably others will be collected in the future.

MEETING OF AUGUST 10, 1928

A special meeting of the New York Entomological Society and the Brooklyn Entomological Society was held at 8:15 P. M., in the new restaurant of the American Museum of Natural History; Messrs. Bird and Davis presiding with Dr. Lutz introducing the speakers.

Among the guests present were: Dr. George H. Sherwood, Dr. F. A. Lucas, Dr. Frank M. Chapman, of the American Museum, through whose courtesy appropriate refreshments were provided, and a number of European entomologists including Dr. Karl Jordan, secretary of the International Entomological Congress, James E. Collin, president Entomological Society of London. Dr. James Waterston and Messrs. Edwards, Riley and Tams of the British Museum, Dr. Charles Hose of the British Empire Forestry Association, G. Talbot of the Hill Museum, Witley; L. E. S. Eastham of Cambridge University; also Dr. Louis B. Prout, G. A. Wilson, O. W. Richards, from England; Antoine Ball and A. d'Orchymont from Belgium; Dr. Hassan C. Effletoun Bey from Egypt; P. Vayssiere, Dr. René G. Jeannel, Prof. E. L. Bouvier, Dr. Robert Regnier, L. Regnier, J. Sainte Claire Deville and Percy T. Lathy, from France; Prof. Filippo Silvestri from Italy; Lief R. Natvig from Norway; Don Jaime Nonell y Comas, Don Gonzalo Ceballos, Dr. C. Bolivar y Pieltain; Fred Muir from Honolulu.

Among the members present were: Dr. Wm. J. Holland, Engelhardt, Curran, Schaeffer, Miss Dobroschky, Bueno, Olsen, Watson, Barber, Miner, Felt, Chapin, Leale, Bromley, Neilson.

Addresses of welcome to the visitors from abroad were made by President Henry Bird for the New York Society, and President William T. Davis for the Brooklyn Society.

Replies were made by Mr. Collin for England, Prof. Bouvier for France, Antoine Ball for Belgium, Dr. Bolivar for Spain, Mr. Natvig for Norway, Prof. Silvestri for Italy, and Effletoun Bey for Egypt; all expressing their appreciation of the successful efforts of Dr. Lutz. Mr. Collin referred to the tramp in the Staten Island woods on August 8 with Mr. Davis as one of the pleasantly memorable features.

MEETING OF OCTOBER 1, 1928

A regular meeting of the New York Entomological Society was held at 8 P. M. on October 1, 1928, in the American Museum of Natural History; President Henry Bird in the chair, with seventeen members and four visitors present.

The following letter was read:

Cincinnati, August 22, 1928

Dear Sir:—As secretary of the party of European entomologists who travelled on the Tuscania and who were able to enjoy a delightful stay in New York before the commencement of the Congress, it is my privilege to thank you and your fellow members of the New York Entomological Society for your great kindness in providing transportation for beautiful trip to Tuxedo Bear Mountain and Yonkers. The opportunity which this trip gave us of seeing the beautiful scenery of these districts, as well as the magnificent laboratories of Mr. Loomis and the Boyce Thompson Institute, was most deeply appreciated by us all, and we shall long remember this day as one of the outstanding features of our visit to your country.

Thanking you again most cordially

Sincerely yours,

HILDA JORDAN.

Dr. Lutz reported as chairman of the August Entertainment Committee. With the cooperation of the following, viz: New York Entomological Society and its president, Brooklyn Entomological Society, American Museum of Natural History, Loomis Laboratory of Physics, Palisades Park Commission, New York Zoological Garden, New York Botanical Garden, Brooklyn Museum and Staten Island Museum, he had been able to provide appropriate entertainment during the time the Tuscania party were in New York, including visits to each institution and an auto bus ride through Tuxedo, Interstate Park, and Yonkers, with refreshments where needed. The bus caused some delay, which enabled the visitors to do some unexpected collecting. The entertainment closed with a dinner as guests of the American Museum of Natural History, which was followed by a joint meeting of the New York and Brooklyn Entomological Societies.

Mr. C. H. Curran, proposed for membership by Mr. Bromley, was immediately elected, the by-laws suspended for the purpose.

The president called for reports on summer collecting.

Mr. Angell had visited North Carolina and Washington, D. C., and later in the season Ellenville and other places in Sullivan Co., N. Y. He exhibited a box of specimens.

Mr. Barber had spent February to May in a trip to California in the course of which he had visited Pasadena, Los Angeles, San Diego and San Francisco and met Muchmore, Wright, Van Dyke, Blaisdell, Leach, Van Duzee, Bruner and other west coast naturalists. In San Francisco he was fortunately in time for the annual Entomological picnic. Every opportunity for collecting was used and Mr. Barber promised to show later some of his trophies.

Mr. Bromley had had the good fortune to meet the rabbit bot fly (*Cuterebra buccata*) or an allied species in July while collecting in an open glade in a Massachusetts pine forest. It flew close to the ground and was apparently following rabbit tracks. He gave also notes on *Promachus* and *Gomphus*.

Mr. Chapin described the interesting character in the vicinity of Boonville in the northern part of Oneida County.

Mr. Hunter, who had been traveling from February, 1926, to May, 1928, spoke briefly.

Mr. Long reported a dead specimen of *Popillia japonica* found August 31, the first collected on Staten Island.

Mr. Nelson, Mr. Weiss, Mr. Davis, Dr. Lutz discussed the egg laying period of the Mole cricket. Reference was made to the publications on the subject in the Society's Journal and to Rutherford, N. J., as the locality where the European species had been found; also to one occurrence of the House cricket on Staten Island.

Mr. Davis exhibited a box of insects collected in August at Ithaca, during the meeting of the 4th International Entomological Congress. Among them were two species of Cicadas, namely *Tibicen canicularis* and *Tibicen linnei*; the pupal skin of an *Okanagana* probably *rimosa*; a female *Ceuthopholis terristris* Scudder that was dead when found clasping the top of a bolt about one foot above stone in old dam at Buttermilk Falls; the moth *Gnorimoschema gallaeasteriella* Kellicott—emerged from gall on *Solidago latifolia*, etc. He also showed photographs taken at Ithaca and of some of the delegates to the Congress who had visited the Staten Island Museum during the summer. He further showed our three native species of soldier crab named *Gelasinus pugilator, G. pugnax,* and *G. minax.* A male of the last mentioned species had been collected on the North Shore of Staten Island by himself and Dr. James P. Chapin on July 15. He had placed it in a bath tub where it occupied the outlet hole entering as far as it could and placing its large claw across the opening. At night it would explore the bath tub. On the afternoon of August 5 it was observed that the crab had left its retreat and was standing near the middle of the tub. When it discovered it was observed it raised itself on its legs, lifted its large claw slightly and then fell back. The crab was immediately picked up and found to be dead. It was suggested that very few observers had ever seen a crab thus expire.

Mr. Nicolay spoke of journeys to Mt. Washington, Greenwood Lake, and Washington, D. C., where he had obtained Cychrini.

Mr. Sherman spoke enthusiastically of his visits to Ithaca and Hanover where the George F. Baker library excited his admiration. The season closed with Dr. Walther Horn, of Berlin, as his guest and a memorable visit to Staten Island where the collection of Mr. Davis was found on the top floor of the museum.

Mr. Watson had passed three summer months at the Station near Tuxedo with four interesting boys and had made a considerable collection of Lepidoptera notwithstanding the poorest season he remembered.

Mr. Wilmott had found *Magicicada cassinii* in the Catskills and noted the different song and questioned the propriety of considering it a variety of *Septendecim.*

Messrs. Sheridan, Swift and Olsen also spoke briefly.

MEETING OF OCTOBER 16, 1928

A regular meeting of the New York Entomological Society was held at 8 P. M., in the American Museum of Natural History, with President Bird in the chair with twenty-three members present and three visitors—one of them being Mr. Guerney of New South Wales, Australia. It was moved by Dr. Lutz that the next meeting of the society falling on election day be dispensed with. Seconded by Mr. Angell and carried.

Mr. Engelhardt announced that he had just received word of the death of our honorary member Dr. E. A. Schwarz who passed away in a Washington Hospital at 5 o'clock October 15. On motion of Dr. Lutz seconded by Mr. Olsen, Mr. Engelhardt was delegated a committee of one to send our regrets to Mr. H. S. Barber, who was most closely associated with Dr. Schwarz. On motion of Mr. Sherman, second by Mr. Angell, Mr. Engelhardt was requested in telegraphing to add flowers in the amount not exceeding $15.00.

Mr. Curran under the title "Flies, Good, Bad, and Indifferent," made the following remarks: Flies are interesting creatures. This, however, is not remarkable, because in nature everything is interesting if we will but take the time to observe even the commonplace natural phenomena of our surroundings. It is only natural that scientists, no matter what their field of endeavor may be, should look upon their own interests as the most important in a particular branch of science. Entomology is at the present time one of the most important fields of scientific research. This field has such an abundance of species and such huge numbers of each species that where other scientists deal with hundreds or thousands, the entomologist deals with tens of thousands. As in the various sciences, so in the various fields of entomological specialization we find those who believe their own "speciality" is the most important.

He pointed out why specialists of each order might claim importance for their particular group because of their economic aspect. Though he admitted the economic importance of the members of other groups outside of the Diptera he could not recall that any of them had been directly respon-

sible for any event of national importance. He then dwelt upon the great harm done in the world by certain Diptera—notably the mosquito in relation to the decline of a nation and the development of the Panama Canal; the house fly in connection with its spread of typhoid fever, particularly during the Spanish-American war. After charting the various families under the above title, he stated there was much justification for the oft repeated statement that all flies are bad, and mentioned the chief diseases transmitted by flies. In conclusion he listed the main families of the diptera, with the particular rôle they played in the animal world.

The paper was discussed by Messrs. Bromley, Dr. Lutz, Dr. Felt, Mr. Guerney, of Australia, Mr. Nelson and Dr. Melander. Mr. Bromley spoke particularly concerning the interesting habits of some *Asilidæ*, the screw-worm fly and the *Syrphidae*. Dr. Felt asked Mr. Curran which of the Diptera were in his opinion the most injurious. Mr. Curran replied that the question was difficult to answer but probably the blow fly attacking sheep in Australia. Mr. Guerney, of Australia, when called upon remarked that this blow fly was bad only in certain years, and mentioned the peculiar case of a dipterous larva living in crude petroleum in Southern California. Dr. Lutz, Dr. Felt and Mr. Nelson discussed the merits of the electric fly-trap, the latter stating that this kind of a trap had worked well in the day-time against the stable fly at Geneva, N. Y. Dr. Melander stated most emphatically that in his opinion the house fly as a carrier of typhoid, was the most dangerous fly, relating his experiences in dealing with this problem while in the State of Washington.

Mr. John Angell exhibited an uncommon beetle in this vicinity, *Sandalus niger* of the family Rhipiceridae taken at Palisades, N. J., October 8, 1928.

Mr. Ballou from the Japanese Beetle Laboratory at Riverton, N. J., exhibited the egg and various stages of the larva and pupa and adult of the Japanese Beetle.

Mr. Wm. T. Davis showed a number of specimens of the cicada *Okanagana vagans* collected by Mr. F. H. Wymore at Victorville, San Bernardino Co., California, June 29, 1927, and stated that but two specimens had heretofore been known; the type, found in an automobile after an extensive trip in southern California, and a male in the collection of the British Museum labelled Yosemite, July 17, 1922. Mr. Davis also showed a male and female of the melanistic form of the geometrid moth *Nacophora quernaria* var. *atrescens* Hulst, and a number of variations of *Epimecis hortaria* including var. *carbonaria* Haimbach.

H. G. BARBER,
Secretary pro tem.

MEETING OF NOVEMBER 20, 1928

A regular meeting of the New York Entomological Society was held at 8 P. M., in the American Museum of Natural History, with President Henry Bird in the chair and twenty-seven members and fourteen visitors present.

The curator and librarian reported changes in progress in the local collection and books to obtain more space in the Society's room.

The program committee reported Dr. Melander as the speaker at meeting of December 4.

Dr. J. P. H. Marker, 357 Ninth St., Brooklyn, N. Y., was elected a member of the Society.

Several letters were read; one from the Entomological Society of Egypt was referred to the librarian with power.

The President exhibited Dr. Melander's work on Empididae in Genera Insectorum with commendation.

Dr. Lutz made an address on ''Experiments with Insects'' being studies on the chirping of crickets, on the effect of temperature on the speed of insects in walking, and on the resistance of insects to changes in barometric pressure. The apparatus employed was described and revealed an ingenuity which was interesting, as was also the use of such expressions as ''dechirped'' and ''Coolidge bugs'' which did not choose to run. The results of these experiments will be announced in due time but it may be said that the ability of these ''Masterpieces of Creation,'' as Dr. Lutz called them, to withstand extraordinary changes in barometric pressure was amazing.

Several members joined in the discussion which followed.

Mr. Engelhardt spoke of the accident by which Mr. Perry Glick had been injured while studying insects in the air with an aeroplane.

Mr. Hartzell exhibited a photograph of a cicada nymph emerging from the egg.

Mr. Davis read a letter from Mr. Stanley W. Bromley in which the writer recorded the cannibalistic habits of the dragonfly *Anax junius* Drury as recently observed by him at Lake Worth, Florida. The dragonflies were exceedingly numerous and on three occasions he had seen large individuals feeding on smaller ones of the same species. Mr. Davis called attention to the note in this Journal for September, 1925, where the capture of *Pentala flavescens* by *Anax junius* is recorded. The securing of such large prey seems to be unusual with *Anax junius* in the north, but not so with the more powerful *Anax longipes*. While on the shore of Lake Okeechobee in May, 1912, *Erythemus simplicicollis* Say was very common and individuals were on numerous occasions seen to capture large moths disturbed in the vegetation and other insects, while in the north it has not been observed to feed on such large insects.

Meeting of December 4, 1928

A regular meeting of the New York Entomological Society was held at 8 P. M. on December 4, in the American Museum of Natural History; President Henry Bird in the chair with eighteen members and six visitors present.

The program committee reported Dr. E. P. Felt as the speaker at the next meeting.

Dr. Lutz made a final report for the Committee on Entertainment of Visitors in August. The Committee was discharged with thanks.

Dr. Moore reported on A. A. A. S. meeting December 27–30, headquarters

Hotel McAlpin. Entomological Dinner 5:30 P. M. Saturday in Flying Bird Hall of the American Museum of Natural History; Prof. W. M. Wheeler the speaker Saturday evening.

Dr. Lutz suggested an entomological meeting Sunday afternoon with refreshments. On motion, duly seconded and carried, $50 was appropriated for this purpose and Mr. Mutchler, Dr. Melander and Miss Dobroschky were appointed a committee of arrangements.

Mr. Davis proposed for membership Dr. J. L. Horsfall, 597 Bellevue Ave., Yonkers, N. Y. On motion, duly seconded and carried, the By-Laws were suspended and Dr. Horsfall was elected.

Dr. Melander spoke, with illustrations by lantern slides on "Some Industrious Hymenoptera." He described the provisions for the young made by Bembex, Sphex, Pepsis and other Hymenoptera, with photographs from life of his own taking. He showed the number of flies with which one nest was supplied, 96, and estimated that the mother must have flown fifty miles to accomplish her purpose. He closed with an account of the battle between *Andræna* and *Mutilla* as an example of the continual struggle for life.

In the discussion that followed Mr. Schwarz commented on the instinctive knowledge of botany and entomology shown by these insects; Mr. Davis described the position, legs up, in which *Sphex speciosus* carries a cicada; Dr. Curran remarked on the habit of tachinid flies of depositing larvae, not eggs. Dr. Lutz and Mr. Bird also discussed the matter.

Mr. Watson exhibited the butterfly *Eurymus eurytheme f. amphidusa f* ♀ *pallida* Cockerell with a note thereon printed in Miscellaneous Notes.

Mr. Davis also exhibited a specimen of the same form captured at Tompkinsville, October 7, 1928.

Mr. Curran exhibited a fly which has the habit of biting off its own wings, on which further notes will later be printed.

Mr. Davis exhibited a male and a female pink katydid, *Amblycorypha oblongifolia* De Geer, collected on Staten Island in 1928, in which the pink color had been preserved better than usual and explained that after the insects had been spread on a board that they had been allowed to dry under naphthalin which had been spread over each specimen. He suggested that the result might have been even more satisfactory if dichlorobenzene had been used. While the color in green or brown katydids may be preserved by soaking them for a time in formalin, this treatment has not proved successful with pink insects.

MEETING OF DECEMBER 18, 1928

A regular meeting of the New York Entomological Society was held at 8 P. M., on December 18, 1928; President Henry Bird in the chair, with twenty-one members and about a dozen visitors present.

The treasurer presented a letter from the Farmer's Loan and Trust Co., stating the condition of the Society's investments.

The following resolution was, on motion by Dr. Lutz, seconded by Mr. Angell, unanimously adopted.

Resolved, That William T. Davis, treasurer, and Henry Bird, president, are hereby jointly and severally authorized and empowered to sell and assign the following United States bonds registered on the books of the Treasury Department in the name of, or assigned to New York Entomological Society.

Title of Loan	Serial Number	Denomination	Form of Registration
U. S. A. 3d L. L.	497715	$100	n/o New York Entomological Society

And it is further resolved, That any and all assignments of the above-described United States bonds, heretofore or hereafter made by the above-named officers, are hereby ratified and confirmed.

The librarian reported accessions.

The meeting falling on January 1, 1929, was, by unanimous vote, omitted.

Mr. Mutchler reported arrangements made by the Committee of which he was chairman for the reception of Entomologists, attending the American Association for the Advancement of Science meeting, on Sunday, December 30, from 2 to 5 P. M.

Dr. Moore announced the invitation to a Philharmonic concert at the same hours and it was also disclosed that other festivities would tend to divide the attendance of the visitors.

Mr. Barber proposed for membership Mr. J. R. de la Torre Bueno, 11 North Broadway, White Plains, N. Y.

Mr. Olsen read a review of Osborn's Leaf Hoppers of Ohio, which will be printed in Short Notes.

Mr. Bird spoke of the recent Nomenclatorial Opinion No. 104 in which 57 generic names used in Entomology are involved.

The President appointed as a nominating committee Messrs. Barber, Watson, and Sherman.

Dr. Felt made an address on "Gall Midges of America." He told how many years ago he had instructed the late D. B. Young to make collections of the adult midges and of the surprising number of new genera and species that had been thus discovered.

He also spoke of the assistance received from Mr. Howard Notman whose collections had been made on the windows of his house in the Adirondacks.

Dr. Felt discussed the habits of gall midges, the characters on which their primary classification is based, the phenomena of pardogenesis observed in *Miastor,* and the extraordinary appendages to the antennæ.

His remarks were discussed by several members. Dr. Melander especially giving an account of the damage from Hessian Fly and Wheat Midge in the state of Washington, the "bread basket of America" as he styled it, that has materially increased the cost of bread.

Mr. Davis exhibited a female robber-fly *Laphria janus* McAtee taken on the trail of Whiteface Mt., Adirondacks, July 8, 1914. The fly had captured and killed a *Cicindela longilabris* slightly larger than itself. This fly was recently determined by Mr. Stanley W. Bromley and is an addition to the New York State List of Insects.

Mr. Davis referring to his note on dragon flies presented at the meeting of the Society held November 20, read the following from a letter from Mr. Bromley dated Lake Worth, Florida, December 7, 1928. ''Belated individuals of *Anax junius* are still on the wing. Their period of great abundance lasted only about 10 days. Then for a week or so *Erythemis simplicicollis* was very abundant, and as you say, they were certainly a voracious lot. I took many feeding on butterflies, skippers, and other smaller dragonflies. Near the Lake, I found a dead cottonmouth moccasin, about which the screw-worm flies had gathered and several individuals of *Erythemis* were to be seen seizing and devouring these flies. Dragonflies of all kinds are rather uncommon just at present.''

BOOK NOTICE

Elementary Lessons on Insects, by James G. Needham. VIII + 206 pages; 72 illus. (Charles C. Thomas, Springfield, Ill.)

This is a book that will enable one to give an elementary course on insects, almost without a book, or at least without a book that is stuffed with dreary entomological statements, and the fact that Professor Needham is the author is a sufficient guarantee that it is good. Professor Needham believes that "the bane of our schools is bookishness," and so he has prepared a non-technical, practical course in entomology, which aims to have the pupil secure his knowledge through direct observation and experience with living specimens. In this way pupils will have the opportunity to do their own thinking and will know without being told whether or not a grasshopper can be drowned by holding its head under water.

Part I deals with the outside and the inside of an insect and with insect growth; part II, with the principal groups of insects; part III, with injurious insects and their control, and part IV, with collecting, keeping and rearing insects. And there are eighteen lessons, each outlining a work program which should delight pupils, because it gives them something interesting to do, and a laboratory program, with living insects, which gives them something fascinating to watch.

With insects as the chief actors and Professor Needham's book as a guide, even the most depressing pedagogue should be able to give a course on elementary entomology that would excite the envy and admiration of his colleagues.—H. B. W.

ERRATA

Volume XXXVI, No. 3, September, 1928.

Pages 209 and 210. For *ephippiata* read *ephippi.*

Page 226. For *recticornis* Fowl., read *reticulatus* Fowl.

Page 228. Lines 15 and 16 from bottom, for "dorsal node" read "front horn."

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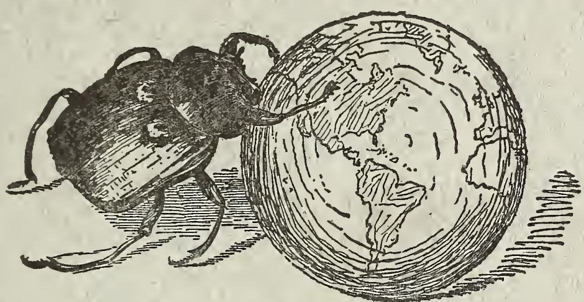
Devoted to Entomology in General



JUNE, 1929

Edited by HARRY B. WEISS

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JOURNAL

OF THE

New York Entomological Society

Vol. XXXVII June, 1929 No. 2

RECORDS AND DESCRIPTIONS OF NEOTROPICAL CRANE-FLIES (TIPULIDÆ, DIPTERA), VI

By Charles P. Alexander
Amherst, Mass.

The preceding part under this general title was published in 1928 (Journal N. Y. Entomological Society, 36: 355–367). The majority of the species described at this time were collected by Doctor J. Chester Bradley in 1919–1920 in Brazil, Argentina, Chile and Peru. The types of these species are preserved in the Cornell University Collection. The additional species were taken by Messrs. E. B. and J. H. Williamson and W. H. Ditzler in Peru and Venezuela and are preserved in my collection. I wish to express my deep appreciation to all the above mentioned entomologists for the opportunity of studying this material.

Genus *Tipula* Linnaeus

Tipula effera, new species.

General coloration yellow, the præscutum with three shiny ferruginous-yellow stripes; two dark spots at cephalic margin of median præscutal stripe; antennæ (♂) very long; male hypopygium with the eighth sternite very large, forming a conspicuous trough-like structure in which the ninth sternite rests, the outer lateral angles produced into powerful spikes.

Male.—Length about 17 mm.; wing 17 mm.; antenna about 14 mm.

Frontal prolongation of head yellow, the nasus relatively small; palpi entirely yellow. Antennæ (♂) very elongate, as shown by the measurements; scape yellow, the flagellum black, with the extreme bases of flagellar segments one to five a little paler; flagellar segments with a single long verticil at near midlength in addition to the basal whorl. Head shiny olive yellow.

Mesonotum yellow, the præscutum with three shiny ferruginous-yellow stripes that are scarcely differentiated against the ground-color, the cephalic margin of the median stripe with a conspicuous black spot at each anterior lateral angle. Pleura yellow. Halteres obscure yellow. Legs with the coxæ and trochanters yellow; remainder of legs brownish yellow, the tarsi passing into brown. Wings with a brownish yellow tinge, the base, costal margin and cell Cu_1 more yellowish; stigma oval, pale brown; veins brown, those in the flavous areas brighter. Venation: Rs relatively short, gently arcuated; R_2 distinct, about one-half the free tip of Sc_2; R_{1+2} entirely preserved; cell *1st* M_2 relatively long, the outer end narrowed and pointed; petiole of cell M_1 shorter than m.

Abdomen yellow, the tergites with an interrupted median pale brown stripe; a narrow brown streak on basal portions of lateral margins of tergites, forming a very interrupted stripe; segment seven chiefly blackened, the margins pale; hypopygium pale. Male hypopygium with the caudal margin of the ninth tergite nearly equally tridentate, the lateral teeth a little more obtuse than the median, the margins of all three blackened. Ninth sternite and basistyle greatly reduced in size. Eighth sternite large, forming a conspicuous trough-like structure in which the ninth sternite lies; outer lateral angles produced dorsad into powerful reddish spikes; margin of the sternite just cephalad and mesad of these spines produced into smaller lobes.

Habitat.—Peru.

Holotype, ♂, San Ramon, July 12, 1920 (J. H. Williamson).

The present species appears to be a member of the *macrosterna* group, characterized by the very powerful development of the eighth sternite of the male hypopygium. It differs from all members of the group in its large size, very elongate antennæ and the details of structure of the hypopygium.

Genus *Tanypremna* Osten Sacken

Tanypremna perornata, new species.

General coloration brown; head chiefly dark brown, the genæ and anterior vertex whitish; pleura pale, with a narrow oblique dark dorsal stripe; fore tibiæ whitish at base; all tibiæ black with a broad white subterminal ring; basitarsi black, with a broad white ring beyond midlength; second tarsal segment with the base blackened, the remainder of the segment white; wings brownish yellow, the costal margin and stigma darker; a dark cloud adjoining *r-m*; cell *1st* M_2 wide at base.

Male.—Length about 20 mm.; wing 13 mm.

Female.—Length about 27–35 mm.; wing 15–18 mm.

Frontal prolongation of head short, pale yellow, including the short nasus; palpi yellow, the first and third segments extensively darkened.

Antennæ short, the scape pale yellow, the flagellum dark brown. Head chiefly dark brown, the relatively broad anterior vertex whitish; genæ conspicuously white.

Mesonotal præscutum chiefly covered by three dark brown stripes, the humeral region paler; interspaces conspicuously channelled; remainder of mesonotum dark brown, including the ventral pleurotergite, the median region of the scutum and base of scutellum slightly golden pollinose. Pleura chiefly pale yellow, the dark girdle of *opilio* indicated by a weak suffusion on the anepisternum and ventral sternopleurite; a narrow oblique dark line extends from the humeral region of praescutum across the dorso-pleural membrane onto the posterior portion of the anepisternum; pteropleurite almost white. Halteres pale, the knobs dark brown. Legs with the coxæ pale yellow, the outer face of the middle coxæ with a small brown area; posterior face of posterior coxæ with a similar linear streak; trochanters pale yellow; femora brown, the tips passing into darker brown, the bases more yellowish; fore tibiæ with an ill-defined whitish ring at base; all tibiæ black with a broad white subterminal ring, this broadest on the posterior tibiæ where it includes nearly one-third the length; basitarsi black with a broad white ring beyond midlength, narrowest on the middle legs, broadest on the posterior legs where it includes more than one-half the entire segment; second tarsal segment with the base blackened, the remainder of the tarsi snowy-white, the terminal segments a little darkened; middle legs of type male with the base of the third tarsal segment restrictedly darkened. Wings with a brownish yellow suffusion, the costal margin and especially cell *Sc* brown, the latter concolorous with the small stigma; a brown cloud at and adjoining *r-m*; veins dark. Venation: Free tip of Sc_2 and R_{1+2} entire, extending parallel and close together to the margin; *r-m* close to the fork of *Rs*; cell *1st* M_2 with the proximal end wide, as in *longipes*.

Abdominal tergites dark brown, with narrow whitish baso-lateral triangles; sternites obscure yellow, the tips of the basal segments narrowly darkened; a subterminal dark brown ring; sternite of the hypopygium obscure yellow, the tergite dark.

Habitat.—Venezuela, Peru.

Holotype, ♂, La Fria, Tachira, Venezuela, April 14, 1920 (E. B. and J. H. Williamson and W. H. Ditzler).

Allotopotype, ♀, April 12, 1920.

Paratopotype, ♀, with the type. An additional specimen, which may be considered as being a paratype, is in the British Museum, collected at Yurimaguas, Peru, by Parish.

Tanypremna perornata is allied to *P. longipes* (Fabricius), differing in the large size, different body-coloration and in the details of pattern of the legs. I am greatly indebted to Mr.

Edwards for comparing this species with the type of *opilio* Osten Sacken and indicating its distinctness.

Genus *Habromastix* Skuse

Habromastix lemniscata, new species.

General coloration dark brown; antennæ 10-segmented in both sexes, in male nearly as long as the body, yellow, the distal segments blackened; thoracic pleura chiefly yellowish testaceous with two narrow dark brown transverse bands; legs yellow, the tips of the femora and tibiæ darkened; wings strongly yellowish, the costal region brown, the bases of cells *R* and *M* and a large area on the anterior cord similarly darkened.

Male.—Length about 12 mm.; wing 13 mm.; antenna about 11 mm.

Female.—Length about 15 mm.; wing 12.8 mm.; antenna nearly 2 mm.

Frontal prolongation of head yellow, without nasus; palpi black, the incisures of the basal segments vaguely paler. Antennæ with 10 segments in both sexes, in male very elongate, nearly as long as the remainder of the body, yellow, on the fourth flagellar and succeeding segments passing into black; flagellar segments elongate-cylindrical, with a dense erect white pubescence and short verticils that do not exceed the pubescence in length; terminal segment very long, approximately two-thirds the penultimate. In the female, the antennæ are short, the terminal segment exceeding the penultimate. Head pale brownish yellow, in the female darker posteriorly; vertical tubercle simple, conspicuous.

Pronotum brownish black, obscure yellow in front. Mesonotal præscutum dark brown, the lateral margin of the præscutum behind the pseudosutural foveæ yellow; parascutella testaceous. Pleura chiefly yellowish testaceous, with two narrow dark brown transverse bands, the first extending from the pronotum across the propleura, including the fore coxa; the second band begins just before the wing-root, including the posterior margin of the anepisternum and sternopleurite and the middle coxæ; the posterior pleurites and posterior coxæ less evidently darkened. Halteres of moderate length, yellow, the knobs infuscated. Legs with the coxæ as described above; trochanters brownish yellow; femora obscure yellow, the tips narrowly darkened; tibiæ obscure yellow, the tips less distinctly darkened; tarsi brown, the terminal segments passing into black. Wings with a strong yellow ground-color, the costal margin brown, this color including the prearcular region, all of cells *C*, *Sc* and Sc_1, the broad bases of cells *R* and *M*, the stigmal region, a very large cloud on the anterior cord, the origin of *Rs* and a narrow seam along M_{3+4}; veins pale brownish yellow, darker in the infuscated areas. Venation: Sc_1 preserved; free tip of Sc_2 without macrotrichia in female; R_{2+3} approximately in alignment with the long R_3; cell M_1 from one and one-half to two and one-half times its petiole.

Abdomen with the basal tergites yellow, black medially; on the second and succeeding tergites the caudal margins likewise blackened; hypopygium

black; sternites yellow, the caudal margins blackened, the median area less evidently so. Male hypopygium of simple structure, the basistyle elongate; ninth tergite with a U-shaped median notch, the lateral lobes low and obtuse. Ovipositor with the valves elongate, chitinized, approximately straight.

Habitat.—Brazil.

Holotype, ♂, Rio de Janeiro, October, 1919 (J. C. Bradley).

Allotopotype, ♀.

The assignment of the present species to *Habromastix* certainly seems correct, although the antennæ are more reduced in number of segments than in the genotype.

Genus *Orimarga* Osten Sacken

Orimarga funerula, new species.

General coloration black, the abdomen violaceous black; halteres and legs brown; wings with a strong brown suffusion, the veins darker brown; R_{1+2} very long, exceeding M_{3+4}; vein and cell *2nd A* relatively short.

Male.—Length about 6 mm.; wing 5.6 mm.

Rostrum and palpi black. Antennæ black throughout; flagellar segments oval, decreasing in size outwardly. Head black.

Thorax black, very vaguely dusted with gray. Halteres dark brown throughout. Legs with the coxæ and trochanters dark brown; remainder of legs brown. Wings with a strong brown suffusion, the veins darker brown; a whitish longitudinal streak along veins M and M_{1+2} to the wing-apex in cell R_5; a similar pale streak along vein M_{3+4}, not reaching the margin. Venation: Sc_2 preserved, R_1 alone being longer than *m-cu*; Rs very long; R_{1+2} very long, at least five times R_{2+3}; basal section of R_{4+5} long, weakly angulated; cell M_3 deep, nearly twice its petiole; *m-cu* about opposite two-thirds the length of Rs; vein *2nd A* relatively short, the cell correspondingly narrow, especially at outer end.

Abdomen violaceous black, the hypopygium dark.

Habitat.—Peru.

Holotype, ♂, Tambo eneñas to Dos de Mayo, Camp del Pichis, July 5, 1920 (J. C. Bradley).

Genus *Austrolimnophila* Alexander

Austrolimnophila bradleyi, new species.

General coloration obscure yellow; antennæ (♂) short, the flagellum weakly bicolorous; head dark brownish gray; mesonotal præscutum with three distinct brown stripes; halteres very long; legs yellow, the femoral tips narrowly and vaguely darkened; wings yellowish, with an abundant pale

brown dotting in all the cells; petiole of cell M_1 shorter than m; male hypopygium with two dististyles.

Male.—Length about 9 mm.; wing 10.5 mm.

Rostrum short, a little less than the first scapal segment of antenna, pale brown; palpi dark brown. Antennæ relatively short, if bent backward extending about to the wing-root; basal segments of organ pale brown, the intermediate segments more bicolorous, the base of each segment being dusky, the apex yellow; outer segments more uniformly darkened; flagellar segments passing through oval to elongate. Head dark brownish gray; anterior vertex narrow, about one-half wider than the diameter of the first scapal segment.

Pronotum obscure yellow. Mesonotal præscutum obscure yellow with three distinct dark brown stripes, the lateral pair shortened; no tuberculate pits; pseudosutural foveæ scarcely apparent, marginal; scutal lobes chiefly dark brown, the posterior-lateral angles paler; scutellum with a yellowish pollen; postnotum pale, sparsely pruinose. Pleura pale yellowish brown, variegated with dark brown, including areas on the propleura, the dorsal sternopleurite and ventral sternopleurite; a smaller and darker area on the meron above the middle coxa; dorsal portion of pteropleurite somewhat clearer yellow. Halteres unusually elongate, obscure yellow, the base of the stem brighter yellow, the knobs weakly infuscated. Legs with the coxæ and trochanters yellow; femora yellow, the tips narrowly and vaguely darkened; tibiæ and tarsi yellow, the tips of the latter a little darkened. Wings with the ground-color yellowish, with an abundant pale brown dotting in virtually all the cells, these areas in places so numerous as to be confluent or nearly so; slightly larger and darker areas at fork of Sc and on R_2 and R_{1+2}; cell Sc without markings except a spot above the origin of Rs and at outer end of the cell; veins pale yellowish brown. Venation: Rs long, angulated at origin; R_{2+3+4} a little longer than rm; R_2 about three-fifths R_{1+2}; R_3 and R_4 nearly parallel to one another almost to the margin; inner ends of cells R_4, R_5 and *1st* M_2 in transverse alignment or nearly so; cell M_1 very deep, the petiole shorter than m; cell *1st* M_2 widened outwardly; *m-cu* about its own length beyond the fork of M.

Abdominal tergites dark brown, the caudal margins of the segments narrowly ringed with yellow; basal sternites more uniformly yellowish; a subterminal darker ring; hypopygium obscure yellow. Male hypopygium with the interbasal lobes of basistyle very large and conspicuous, enlarged outwardly, their tips obtuse. Outer dististyle terminating in a long acute spine. Inner dististyle longer, gently arcuated, the apex obtuse. Gonapophyses with the mesal angle produced into a long spine that is directed to a smaller spine at the outer lateral angle, the two appearing irregularly pincer-shaped. Ædeagus very short.

Habitat.—Argentina.

Holotype, ♂, in poor condition, Parque Aconquija, Tucuman, February 24, 1920 (J. C. Bradley).

I take great pleasure in naming this interesting crane-fly in honor of Professor J. Chester Bradley, to whom I am greatly indebted for many kindnesses in the past. By means of the author's keys to the Chilean and Patagonian Tipulidæ (Diptera of Patagonia and South Chile, Part I—Crane-flies, published by the British Museum of Natural History, 1929), the present species runs to *A. merklei* Alexander (l. c., p. 116). The latter species, although generally similar in appearance, differs in the coloration, long petiole of cell M_1 and, especially, the structure of the male hypopygium.

Genus *Limnophila* Macquart

Limnophila filiformis, new species.

General coloration brown; antennæ (♂) elongate, approximately as long as the body, the segments with long outspreading verticils; halteres very long; wings with a pale brown suffusion; cell M_1 lacking; male hypopygium with the outer dististyle broadly obtuse at apex.

Male.—Length about 3.5 mm.; wing 4.5 mm.; antenna about 3.5 mm.

Rostrum pale brown, palpi darker. Antennæ (♂) elongate, filiform, dark brown throughout; flagellar segments elongate-cylindrical, with long outspreading verticils throughout their length; terminal segment very small, oval. Head dark brown, sparsely dusted with gray.

Mesonotal præscutum brown, the lateral margin a little brighter, tuberculate pits and pseudosutural foveæ lacking; scutum and scutellum testaceous brown; postnotum more yellowish. Pleura brown, more yellowish behind. Halteres very long and slender, pale brown, the knobs a little darker. Legs with the coxæ and trochanters yellowish testaceous; remainder of legs brown. Wings with a pale brown suffusion, the veins a little darker, especially the costal and radial veins; veins beyond the radial field very pale and delicate. Sparse macrotrichia on all longitudinal veins beyond the cord. Venation: Sc_1 ending shortly before the fork of Rs, about twice the length of the transverse Sc_2; Rs long, strongly arcuated at origin; R_{2+3+4} subequal to the basal section of R_5; R_2 faint to subobsolete; veins R_3 and R_4 diverging strongly, so cell R_3 at margin is very wide; inner ends of cells R_4, R_5 and *1st* M_2 in transverse alignment; cell M_1 lacking; *m-cu* about two-thirds its length beyond the fork of M.

Abdominal tergites dark brown, the sternites more yellowish. Male hypopygium with the outer dististyle a simple rod, the apex broadly obtuse, the surface of the style set with conspicuous erect setæ. Inner dististyle a little shorter, gently arcuated, with two long apical setæ, in addition to scattered erect setæ over the surface. Gonapophyses appearing as oval, obtuse plates, without evident spines or hooks. Ædeagus short.

Habitat.—Chile.

Holotype, ♂, Butalcura, Chiloë Island, April 4–5, 1920 (J. C. Bradley).

In its very elongate antennæ, *Limnophila filiformis* differs conspicuously from all similar species of *Limnophila* and *Shannonomyia* in the Chilean subregion.

Genus *Shannonomyia* Alexander

Shannonomyia longiradialis, new species.

General coloration brown; antennæ dark, the scapal segments paler; legs brownish yellow, the terminal tarsal segments darker; wings subhyaline, the oval stigma only vaguely darker; *Rs* very long, exceeding the combined veins R_{2+3+4}, R_{2+3} and R_3; cell *1st* M_2 small, the veins issuing from it elongate.

Male.—Length about 5.3 mm.; wing 6.5 mm.

Rostrum and palpi dark brown. Antennæ short, if bent backward scarcely attaining the wing-root; scapal segments brown, the flagellum black; flagellar segments truncated oval, the verticils a little longer than the segments. Head dark.

Pronotum brown. Mesonotal præscutum obscure yellow with a median brown stripe that is better indicated in front; posterior portions of præscutum more pruinose, the humeral region more brightened; lateral præscutal stripes feebly indicated; no tuberculate pits or pseudosutural foveæ; scutum dark brown, sparsely pruinose; scutellum a little brighter; postnotum darkened. Pleura obscure brownish yellow, the dorsal portions discolored. Halteres pale, the knobs obscure yellow. Legs with the coxæ and trochanters brownish testaceous; remainder of legs obscure brownish yellow, the terminal tarsal segments darker. Wings subhyaline, the oval stigma only vaguely darker; veins pale brown. Venation: *Sc* relatively long, Sc_1 ending just before the fork of *Rs*, Sc_2 at its tip; R_1 arched over the stigma; *Rs* very long for a member of this genus, longer than the combined R_{2+3+4}, R_{2+3} and R_3; R_2 very faint to nearly obsolete, subequal to R_{1+2}; veins R_3 and R_4 divergent; inner ends of cells R_4, R_5 and *1st* M_2 in oblique alignment, the last most proximad; cell *1st* M_2 very small, the veins issuing from it unusually long; cell M_1 absent; *m-cu* nearly its length beyond the fork of *M*.

Abdomen dark brown, the subterminal segments yellow, the hypopygium dark. Male hypopygium with the outer dististyle distinctly bifid at apex. Inner dististyle much shorter, terminating in two long setæ. Gonapophyses broad-based, the mesal hook conspicuous, the notch that it forms subcircular in outline. Besides the apophyses there is an elongate pale plate lying in the genital chamber. Ædeagus elongate, the basal portion strongly sinuous.

Habitat.—Chile.

Holotype, ♂, Ancud, Chiloë Island, April 2–7, 1920 (J. C. Bradley).

Shannonomyia longiradialis is readily told from all other members of the genus by the venation, especially the unusually long *Rs*, in conjunction with the structure of the gonapophyses.

Genus *Eriocera* Macquart

Eriocera breviuscula, new species.

General coloration black, dusted with gray; head above entirely orange-yellow; antennæ black, the scape orange; humeral region of præscutum velvety black; wings tinged with grayish; cell R_3 very short; abdomen velvety black, the bases of the segments gray pruinose, producing a dimidiate appearance; genital segments orange.

Female.—Length 15 mm.; wing 11 mm.

Rostrum very short, brown; palpi dark brown. Antennæ short, the scape orange, the flagellum black. Head entirely orange-yellow; vertical tubercle high, distinctly bifid.

Pronotum brownish black. Mesonotum black, dusted with gray, to produce a plumbeous appearance; humeral region of præscutum velvety black; scutellum more reddish brown. Pleura dark, the surface with a microscopic appressed pruinosity. Halteres relatively short, obscure yellow, the knobs brownish black. Legs with the coxæ and trochanters dark, concolorous with the thorax; remainder of legs broken. Wings with a grayish suffusion, cell *Sc* darker brown; anterior cord weakly tinged with brown; *Rs* and R_5 vaguely tinted with darker; veins dark brown. Venation: Cell R_3 very short, R_2 being about two-thirds of R_{3+4}; cell M_1 lacking; cell *1st* M_2 elongate; *m* transverse; *m-cu* about one-third its length beyond the fork of *M*, about one-third longer than the distal section of Cu_1.

Abdominal tergites velvety black, the basal portion of the individual segments gray pruinose, the cephalic lateral portion restrictedly obscure yellow; sternites dark, sparsely pruinose. Genital segments fiery orange. Ovipositor with the tergal valves long and slender, almost straight, the acute tips gently upcurved, the bases blackened.

Habitat.—Peru.

Holotype, ♀, La Chororra, Putumayo District, August 17–20, 1920 (J. C. Bradley).

Eriocera breviuscula is generally similar to *E. flaviceps* (Wiedemann) of Brazil in the short cell R_3, differing in the coloration of the body and wings.

Genus *Molophilus* Curtis

Molophilus tucumanus, new species.

Belongs to the *plagiatus* group; general coloration dark brown; antennæ (♂) elongate; wings broad, tinged with dusky; vein *2nd A* relatively

elongate; male hypopygium with the basal dististyle a long gently arcuated rod, the apex densely set with spines, the mesal face with a linear series of six to eight conspicuous setæ.

Male.—Length about 3.8 mm.; wing 4.2 mm.

Rostrum and palpi black. Antennæ (♂) dark brown throughout, if bent backward extending nearly to the root of the halteres; flagellar segments long-oval, with elongate verticils. Head dark brownish gray.

Mesonotum dark liver brown, the humeral region of the præscutum a little more brightened; lateral pretergites only vaguely brightened. Pleura concolorous with the notum. Halteres with the stem pale, covered with golden setæ, the knobs infuscated. Legs with the coxæ brownish yellow, the trochanters a little more testaceous; legs brown, the terminal tarsal segments somewhat darker; fore legs broken. Wings broad, with a dusky tinge, the stigmal region somewhat darker; veins darker brown than the ground-color; macrotrichia dark brown. Venation: R_{2+3} elongate, nearly straight; R_2 a little beyond level of *r-m*; petiole of cell M_3 less than twice *m-cu*; vein *2nd A* relatively long, ending beyond midlength of the petiole of cell M_3.

Abdomen dark brown, including the hypopygium. Male hypopygium with the apical beak of the ventral lobe of the basistyle long and nearly straight. Outer dististyle stout, the long slender inner arm sinuous, narrowed to the obtuse apex. Basal dististyle a long, gently arcuated rod, a little widened outwardly, the outer face with microscopic appressed denticles, the apex densely set with longer spines; mesal face of style at near midlength with a linear series of from six to eight long conspicuous setæ. Ædeagus broad.

Habitat.—Argentina.

Holotype, ♂, Parque Aconquija, Tucuman, February 24, 1920 (J. C. Bradley).

Molophilus sicarius, new species.

Belongs to the *plagiatus* group; general coloration reddish brown, sparsely pruinose; pleura pale, with a conspicuous dark brown longitudinal stripe to the postnotum, interrupted on the pleurotergite; male hypopygium with the basal dististyle a long, powerful, gently arcuated rod, the mesal margin with a close series of long spines to produce a wing-like appearance; near base on outer margin a small gently curved rod that is densely set with microscopic spiculæ.

Male.—Length about 4.2 mm.; wing 5 mm.

Rostrum pale testaceous; palpi dark brown. Antennæ short, if bent backward not attaining the wing-root; first flagellar segment pale, the remainder dark brown. Head pale.

Pronotum dark. Mesonotal præscutum reddish brown, very sparsely pruinose, the humeral region extensively yellow; scutellum more testaceous brown, especially behind; posterior portion of the postnotal mediotergite con-

spicuously dark brown. Pleura pale brownish yellow, with a conspicuous dark brown longitudinal stripe, best defined on the anepisternum and pteropleurite, separated from the dark color of the postnotum by the pale pleurotergite. Halteres yellow, the knobs golden yellow. Legs with the coxæ and trochanters yellow; fore femora dark brown, tibiæ yellow, the tips darkened, in male with a swollen brown subbasal ring; tarsi yellow, passing into dark brown. Wings yellow, the veins darker yellow, the macrotrichia bright cinnamon brown. Venation: R_{4+5} short; vein *2nd A* relatively long, extending to beyond the base of the petiole of cell M_3; cell *2nd A* narrow.

Abdomen dark brown, the sternites paler medially; hypopygium obscure yellow. Male hypopygium with the apical beak of the ventral lobe of the basistyle powerful, black, with one or two small denticles immediately cephalad. Outer dististyle bifid, the lateral arm broader, the apex truncated, the inner arm a little longer, more slender, beyond midlength narrowed to the slender obtuse tip. Basal dististyle a long, powerful, gently arcuated rod that terminates in a powerful apical spine; mesal margin of style for more than the distal half with a close series of 14–15 long powerful spines that produce a wing-like appearance; shortly beyond base on outer margin a small gently curved rod that is densely set with microscopic spiculæ. Phallosmic structure appearing as a deeply bilobed setiferous cushion. Ædeagus very long and slender.

Habitat.—Peru.

Holotype, ♂, Ruacapistana, Rio Tarma, June 1–2, 1920 (J. C. Bradley).

Molophilus sicarius somewhat resembles *M. honestus* Alexander (Argentina) but the basal dististyle is distinct in structure.

THE ENTOMOLOGY OF ARISTOTLE

By Harry B. Weiss
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Few entomologists think of Aristotle in connection with their science, yet in addition to his extended activity in the fields of logic, rhetoric, politics, ethics, grammar, poetry, physiology, psychology, and natural history, Aristotle found time to devote some attention to insects as such. Zoology did not assume any definite shape until Aristotle had collected the observations of his precursors, added to them his own numerous findings, and attempted a natural system of classification.

Born in 384 B. C. at Stagira, a Greek colony, about seventy miles eastward from the capitol of Macedonia, Aristotle was brought up in a scientific atmosphere, his father, Nicomachus, having been physician-in-ordinary to the King of Macedonia, Amyntas II, father of Philip and grandfather of Alexander the Great. After the death of Aristotle's parents, when he was quite young, it is stated in some accounts that he was placed under the care of Proxenus, a citizen of Atarneus in Mysia. Here he is supposed to have squandered nearly all of his large inheritance and to have wasted his time in dissolute living, but it is difficult to imagine a comparatively young boy being so very rakish. When he was seventeen he traveled to Athens and commenced the study of philosophy under Plato. Here he lived for some twenty years, at a time when Athens was the center of learning for the entire Greek world. The wealthy citizens lived upon the income from their land, and the manufacturers, when they could afford it, bought land and joined the aristocracy. Skilled workers and small storekeepers crowded the city, and all manual workers were despised and were without social status. The narrow, unpaved streets wound between the unadorned mud-brick walls of low and for the most part windowless houses and were made the repositories of useless refuse from the households. Although the houses of even the wealthy Athenians were bare without, devoid of sanitation, and lacking in what are now

regarded as essential comforts, the interiors were made decorative with exquisite furniture, painted vases and handwrought metal utensils. The lower classes believed in magic and were entertained by wrestling, running, and boxing matches, chariot racing, heavy drinking and games of chance, and the city lived out-of-doors.

Upon the death of Plato in 347 B. C., Aristotle went to Atarneus in Mysia and lived with Hermias, who ruled Atarneus, marrying Pythias, the niece of Hermias, when he was thirty-seven years old. After the Persians had captured and killed Hermias in 344 B. C., Aristotle found life in Atarneus precarious, so he escaped to Mitylene, and two years later he was called to the court of Philip of Macedon to instruct Philip's son Alexander.

Philip, able and skillful in both politics and war, was extending his kingdom northward and eastward, and his activities north of the Ægean, where his conquests conflicted with the interests of the Greek states, were viewed in Athens with both trust and distrust. One party of which Isocrates was the leader was in favor of Philip and looked to him to unite and save the Greek world, while the anti-Macedonian party was led by Demosthenes, who denounced Philip as a barbarian whose object was to reduce the free Greek cities to slavery. After a series of battles, Philip defeated the Greek forces in 338 B. C. and became the head of a league of all the Greek states except Sparta.

During Aristotle's residence in Macedonia, which lasted seven years, he taught Alexander rhetoric, ethics, politics and physics, and continued his research in philosophy. At the court he was greatly respected and liberally supplied with money. Upon the death of Philip, who was treacherously assassinated in 336 B. C., during the wedding festivities of his daughter, Alexander became the King of Macedonia, and soon afterward commenced his Asiatic campaign. Previous to this time Aristotle returned to Athens, where he was well received and given permission to occupy the Lyceum, a large inclosure in the suburbs, where he established his renowned school later called the Peripatetic. In the morning he delivered lectures to select pupils, and in the evening discoursed popularly to the general public. Scholars

were attracted from all parts of Greece, and for some thirteen years the Lyceum flourished. Alexander kept in touch with him and placed at his disposal several thousand men who collected all kinds of animals for him, this material being the basis for his "History of Animals." According to Athenaeus, Aristotle received 800 talents from Alexander so that he could finish his "History of Animals," but doubt is thrown on this by a passage from Aelian.

Following Alexander's death in 323 B. C., brought on most likely by a drunken saturnalia, Aristotle found the atmosphere of Athens unhealthy, because of his friendliness to the Macedonian authority. His enemies among the followers of Plato and Isocrates could not make a political charge against him, as he was not active politically, and so they charged him with impiety because he had written a poem in praise of Hermias and had erected a statue of Hermias at Delphi. Aristotle, fearing that he could not successfully meet the attacks of the anti-Macedonian party, took advantage of an Athenian law which permitted an accused person to avoid a trial by going into exile voluntarily, and escaped to Chalcis in Euboea, where he died naturally soon afterward in 322 B. C., at the age of about sixty-two.

Of his personal appearance, Macgillivray records that he was not highly favored, and Lones describes him, according to ancient writers, as "rather short and slim," with small eyes and lisping speech. Although not robust physically, he was full of energy and action and paid much attention to his personal appearance. According to Antipater, his conduct was polite and persuasive. In his will his family received careful consideration, as did his slaves.

His industry was enormous, and most of his writings were produced from 335 B. C. to 323 B. C., during his stay at the Lyceum. The separation of his work from that of his students and followers has been attended with much difficulty. As a whole his writings are pertinent and the subjects are arranged orderly. The abstract generalization present in some of his books is usually absent in his "History of Animals" and works on zoology wherein "facts" are recorded. Lones states that Aristotle "is

eminently practical and is the first to condescend to regard the observations of things themselves as an important part of the foundation of knowledge.'' As the founder of natural history he attempted to cover an enormous field, and, as would be expected, his mistakes are numerous, due in part to his reliance upon the observations of others. Yet his advances were greater than those of any of his predecessors, and all during the Middle Ages Aristotle's science was thought to be the last word.

Some of his views about insects are set forth below, practically all of them having been extracted from Lones's volume on ''Aristotle's Researches in Natural Science.''[1] There is, of course, always some risk attached to the practice of presenting parts of an author's work as complete entities, without regard for the value of such parts in his whole scheme. However, it is believed that in the case of Aristotle's ''insects'' this can be done without injustice to the author.

Concerning spontaneous generation, Aristotle thought that the vital principle was more important than the accompanying matter, but his views as to how the two came together are not clear. Quoting Lones, Aristotle apparently believed that ''the inanimate matter'' underwent ''some kind of maturing process in the presence of moisture and at a suitable high temperature, the moisture containing some breath of life, and everything being in some way full of vital principle. Then frothy bubbles of this specially prepared matter'' were ''formed, and within these generation'' proceeded ''rapidly.'' The kinds of life so formed depended partly upon the nature of the matter within the bubbles and partly upon ''the nature of the vital principle enclosed.'' An additional statement on this subject by Aristotle is as follows: ''The part of the rudimentary vital principal caught up and enclosed in the breath of life makes the germ or embryo and imparts movement.'' He thought that spontaneous generation took place in some of the flowerless plants, in many of what are now called gastropods and lamellibranchs, and in some insects and fishes. Although these animals are structurally different they resembled each other, according to Aristotle, in being ''engendered'' from inanimate matter. Lones calls attention to the

[1] London, 1912.

fact that "some of these forms of life resemble one another sufficiently to form an assemblage which unites inanimate matter with higher plants and animals, such as flowering plants, insects, crustaceans, cephalopods and the numerous animals constituting Aristotle's Enaima, which corresponds to a large extent with the Vertebrata." Although Aristotle apparently did not believe in generation from the earth itself, he assented to the liability of the production of men and some quadrupeds from such lower forms of life as worms, larvæ or eggs.

As to respiration, he thought that animals without lungs could not respire and that in the case of animals with lungs respiration served only to cool the blood and heart, these being the chief centres of heat. In view of this, his Entoma or insects could not respire, and form supporting evidence he says that insects live when cut into several parts, and that flies and bees swim in water for a long time unless it is very hot or very cold.

Aristotle's description of the insect alimentary canal is very general. Most of his Entoma, according to his writings, have a divisionless canal which passes directly from the mouth to the anus, but in a few it is coiled and in others, like the locust, there is a stomach followed by a straight or coiled intestine.

He believed, correctly, that insects have a sense of smell, and calls attention to the keenness of this sense in bees.

Aristotle paid considerable attention to the transformations of some of his Entoma, and this is set forth as follows by Lones. "All his ENTOMA produce skolekes, or all, except certain Lepidoptera which produce seed-like bodies containing fluid. The passages relating to his skolekes, are too numerous to be given in full, but an epitome of the most important follows, so far as the difficult nature of the subject permits.

"He appears to have been aware of the existence of the ova or eggs of some of his ENTOMA, specially certain butterflies and moths, locusts and spiders, but considered them to be not eggs but egg-like skolekes. The ova of many ENTOMA escaped his notice, but he was aware of the existence of their skolekes, and believed that these were the first products of generation. The skolekes fed, grew rapidly, and underwent changes, more or less complex, until they passed into the pupa or chrysalis form.

"The skolekes of the various kinds of ENTOMA are not treated by Aristotle in the same way. When dealing with those of bees, wasps, and the like, the larvæ are called skolekes right up to the pupa stage; on the other hand, the skolekes of butterflies and moths are said to become kampai, or caterpillars, before they become pupæ. The apparently great difference between the caterpillars of butterflies and moths, and the maggots of bees, wasps, and flies, was probably the cause of this difference of treatment, but he considered both caterpillars and maggots to be skolekes finally into the "real eggs," or pupæ.

"His views on this subject are set forth in fairly clear language. He states that ENTOMA brings forth skolekes at first, but these become egg-like in the course of their development, for the so-called chrysalis is functionally equivalent to an egg. He also says: 'For we must consider caterpillars to be a kind of skolex, and also the (generative products) of spiders, and yet it may seem that some of these and many others resemble eggs, because of their roundness, but they should not be defined by their form, nor their hardness and softness, but by their producing an animal as the result of a change of the whole and not a part. When they have completely attained the skolex form, and have become of full size, they are, as it were, eggs, for the skin hardens about them, and they become motionless at this time. This is evident in the skolekes of bees and wasps and in caterpillars. The reason for it is that, because of the imperfect nature of the animals, their 'eggs' are produced, as it were, before their time, the skolex being, as it were, an egg which is still soft and in process of growth.'

"This is the most important passage on the skolex in all Aristotle's works. It shows clearly, in conjunction with the other passages cited, that his skolex is an immature product of generation, which grows and finally becomes a pupa, or, so Aristotle believed, an 'egg,' giving birth to the perfect animal. It differed from the eggs of a bird, which has a hard shell and does not grow, the young bird being formed from a part of the egg, the remainder serving as food.

"His discussion of the generation of bees is particularly interesting. He refers to the many different opinions which had been

given on the subject, and says that much uncertainty existed about the mode of generation of bees. He seems to think that a kind of hermaphroditism occurs among the workers, and finally decides that the rulers or king (queens) generate both themselves and the workers, that these generate the drones, and that these generate nothing, but are idle, while the queens remain in the hives free from all unnecessary labour.

"It is now known that the queen of a hive generates queens, workers, and drones, the workers being normally barren females, and the drones males; parthenogenesis sometimes occurs. The production of a queen from a fertilized egg depends on the supply of a superior quality of food, called 'royal jelly,' to the hatched-out larva, and this feeding is arranged by those bees which act as nurses. It is sufficient for the queen to be impregnated once only by a drone, for the purpose of depositing vast numbers of fertilized eggs."

Aristotle defined his Entoma as follows: "I call those animals Entoma which have incisions in their bodies, either in their ventral parts, or in these and also their dorsal parts." Although this definition is broad enough to include most of the Arthropoda, Vermes and Echinodermata, Aristotle, according to various qualifying parts in his works, restricted his Entoma to much narrower limits, excluding from it animals not possessing many legs and stating that there is a certain ratio between the number of legs and the length of the body or number of indentations, and that a reduction in the number of legs is made up for by the presence of wings. As a matter of fact, his Entoma are mainly "butterflies, moths, beetles, bees, wasps, hornets, ants, houseflies, gadflies, gnats, dayflies, grasshoppers, locusts, spiders, scorpions, centipedes and millipedes." He separated the crustaceans from his Entoma, which many naturalists who came after him did not. Agassiz said that Aristotle divided the group more correctly than Linnæus.

Aristotle mentions about sixty Entoma, but few of these can be identified. He knew that the locust oviposits in the ground, that the young resemble the parent, and that a complete metamorphosis is lacking. He thought, in common with ancient authors, that the cicada fed on dew only, and that the singing

was due to the "friction of the air on the membrane beneath the hypozoma or part close to the division between the thorax and abdomen." The fact that the males only sing is mentioned by him, but this was well known to the ancients. He states that the cicada lays its eggs in certain plants and in the ground, and speaks of the larva undergoing a kind of transformation. He knew of the mayfly and says that Ephemeron has four legs, four wings, and lives but a day. For several species of Lepidoptera, he uses the word Psyche, and refers to the cabbage butterfly being produced from "something smaller than millet seeds" on the leaves of cabbage. Concerning some of the Geometridæ he says they are produced "from caterpillars which form waves as they walk." He knew that larvæ in woolens resulted in certain species of Tinea, which he called Setes. His Kouleoptera have elytra and are without "stings," but few can be identified although some of his names such as Kleros, Karabos and Melolonthe are, in a modified form, in use at present. His Kantharos is *Scarabæus sacer,* the sacred beetle of the ancient Egyptians, and his larvæ of Kleros are thought to be those of *Trichodes apiarius,* a species which infests beehives. His Karabos has been identified as the rock lobster *Palinurus vulgaris.* Many remarks about bees and wasps are made by Aristotle, and in connection with bees he observes that during each flight they visit only flowers of the same kind.

In the classification of his animals constructed from his writings, two main groups are apparent, the Enaima (Vertebrata) and the Anaima (Invertebrata), and his Entoma form a subdivision of his Anaima or animals without blood. Some authors have reconstructed in some detail the classification of his Entoma, but it is doubtful if Aristotle really had such an orderly arrangement in mind.

Aristotle's most important works on natural history are the "History of Animals," "Parts of Animals" and "Generation of Animals." The influence of his writings as a whole reached its peak during the early part of the 14th Century. Shortly after Dante's time his work began to be reviewed unsympathetically, and after the Revival of Learning the criticism became pronounced, his philosophy and the Church as well being attacked.

Lones states that in 1536, Ramus selected the sweeping title "Everything that Aristotle taught is false" for his thesis leading to a degree at Paris, and defended his arguments so expertly that he obtained it. Patrizi, Bacon, Galileo and other experimentalists all attacked Aristotle's doctrines, and by the first half of the 18th Century he was very much neglected. During the period when the interest in his work was lessening, his zoological work was being given increasing attention. Gesner's "Historia Animalium," is full of Aristotelianisms, and Willughby, Ray and Artedi were all students of Aristotle. A renewal of interest in Aristotle's work commenced in the late 18th and early 19th centuries, and has continued.

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NEW RECORDS AND DESCRIPTIONS OF BEES OF THE GENUS PERDITA (HYMENOPTERA)

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The bees recorded below were received from the Illinois State Natural History Survey, Urbana, Illinois, through the kindness of Dr. T. H. Frison, and from Professor C. P. Gillette, of Fort Collins, Colorado.

1. **Perdita salicis coloradana**, new subspecies.

Perdita salicis Cockerell (*exclamans* group) is a widespread species and has been recorded previously from Las Cruces, New Mexico (type locality); Rifle, Colorado; Phoenix, Arizona; and San Jose de Guaymas, Sonora, Mexico. It also occurs in southern California, where it is differentiated into three well defined races. The new race *coloradana* is based on one female from Delta, Colorado, and apparently should include the specimens recorded by Cockerell from Rifle, Colorado. The male of *coloradana* is not known but I presume that it will be found to differ in no way from typical *salicis,* since the males of the three Californian races show no differentiation whatever.

P. salicis coloradana differs from typical *salicis* as follows: Yellow bands of abdomen restricted, the first tergite being entirely dark, the band on second tergite ending far from lateral margins, and it and the band on following three segments very narrow and basal. In typical *salicis* there is a yellow band on tergites 1 to 5, reaching to lateral margins on all segments, rather narrow, subapical and continued along lateral margins to the base on 1, and broad and basal on following segments. The apical margin of tergite 5 and the whole of 6 are orange brown in *salicis,* but in *coloradana* these parts are pale brown and preceded on 5 by a brownish piceous band. The piceous color predominates on the tergum of abdomen in *coloradana,* while in *salicis* the yellow predominates. The venter is yellow in both forms. Head distinctly more bluish than thorax (only slightly so in *salicis*), the yellow lateral face marks extending along orbits to summit of foveæ (to about the middle of foveæ in *salicis*), the dog-ear plates yellow only on dorsal half so that the dark color of frons descends broadly to clypeus (prac-

tically as in *salicis*). Pleura of thorax entirely dark (in *salicis* there is a small yellow spot on sides of propodeum directly over the hind coxæ). Lateral margins of mesoscutum narrowly yellow (in *salicis* the yellow is restricted to the marginal bead and declivous part beyond, the disk proper showing no yellow). Wings somewhat milky hyaline with pale brownish yellow veins, the subcosta and margins of stigma slightly darker (in *salicis* the wings are less distinctly milky and with slightly darker veins). Antennæ and legs practically as in typical *salicis* except that the front femora are somewhat brownish beneath. Length about 4.5 mm.

Described from 1 female (holotype), collected May 27, 1900, at Delta, Colorado.

Type in the collection of the State Agricultural College, Fort Collins, Colorado.

2. Perdita laticincta Swenk and Cockerell.

1 ♀, 1 ♂, "E. Colo., 7–99," and 1 ♀, Ft. Collins, Colorado.

This and the next four species are included in the *octomaculata* group.

3. Perdita luteiceps Cockerell.

1 ♂, "Colo. 1414," apparently collected by Baker. In the collection of Illinois State Natural History Survey.

On August 11, 1928, I spent a few hours at the Academy of Natural Sciences of Philadelphia examining types of *Perdita*. Among other things I noticed that *Perdita zebrata* Cresson, as represented by the type series, is a composite species. *P. zebrata* was described from seven specimens from Colorado. Three of these (including the lectotype) are *zebrata* as recognized by authors, and the other four can be hardly anything else but the previously unknown female of *P. luteiceps* Cockerell. These differ at once from *zebrata* in having the frons and mesonotum rather dull and in the presence of more or less yellow on the frons. In Cockerell's table (Proc. Acad. Sci. Philadelphia, 1896) it would run near the male of *P. gutierreziæ* Cockerell. The amount of yellow on the frons is very variable. At its greatest development the yellow extends across the lower third of the frons, narrowly ascending on orbits between foveæ and eyes to about the summit of the foveæ, but reaching on their inner

side only to their base. From this point on each side of the frons the line of demarkation slopes obliquely upward toward the median line, where there is a very deep, narrow triangular extension of the yellow almost to the median ocellus, but the line is more or less irregular and jagged especially toward the sides. Sometimes, or perhaps usually, the yellow is interrupted on each side by an oblique dark mark extending from the antennal socket to fovea. In the darker specimens the frons is entirely dark, except sometimes a very small yellow dot in the middle and the dark color descends on each side of face to include the dog-ear plates. Dark parts of the head and thorax dark brassy green with the propodeum bluish. Prothorax mainly yellow with a transverse dark band from one pleuron to the other. Thorax otherwise entirely dark. Abdomen yellow with a narrow brown or piceous band at apex of tergites 1 to 4, and a round dark spot on each side at base of tergites 3 to 5. The dark lateral foveæ of tergite 2 isolated, as they extend from the base only to the middle of the segment. Legs yellow, with the hind tibiæ, excepting the basal third, and hind tarsi above infuscated. Frons and mesonotum densely finely tessellate and rather dull in most aspects, the propodeum more shining.

4. **Perdita opacifrons**, new species.

1 ♂ (holotype), Antonito, Colorado, August 5, 1899.

This runs near *Perdita pectidis* Cockerell and *P. cladothricis* Cockerell in Cockerell's table (1896), but strictly it would run out in the preceding couplet (26) as the abdominal marks appear to be yellowish (discolored by cyanide in type). It differs from *P. pectidis* in somewhat larger size, broader head, very dull and opaque frons and vertex, entirely dark flagellum, larger second submarginal cell, etc. From *P. cladothricis* it differs in having the whitish color of face not extending above lower level of antennal sockets except very slightly at sides, the flagellum entirely dark, the pleura without a white spot, the venter dark, the second submarginal cell very broad below and narrowed about two-thirds above, etc.

MALE: General form ordinary. Head not enlarged, distinctly broader than long and well rounded on sides and above. Cheeks narrow and simple.

Eyes rather less than twice as long as wide and with the inner orbits parallel. Face below antennæ moderately and evenly convex. Clypeus projecting for about one-half its length in front of ocular line; its disk somewhat wider than long, with the truncation at summit between dog-ear plates moderately broad; the lateral extensions short and broad, strongly inflexed and only partially visible in frontal view of head. Dog-ear plates about twice as high as broad and pointed below. Lateral plates of face a little widened at lower ends and opposite middle of dog-ear plates each covering slightly less than one-fourth the total width of face. Prominence between antennæ rather low, tectiform and with the carina extending onto frons and continued above as a smooth shining line which reaches to anterior ocellus. Mandibles rather short, gently curved, tapering and acute at apex, and reaching distinctly less than to far margin of labrum. Antennæ with the scape about twice as long as thick and the middle joints of flagellum as long as thick. Abdomen oval, convex above, about twice as long as wide, and with the apex somewhat recurved toward venter. Seventh tergite evenly narrowed to acute apex. Membrane of wings provided with very fine, short, and moderately dense setæ in apical field, but having the venational area nearly bare. Stigma narrowly lanceolate, about as long as the first submarginal cell and emitting the radius slightly beyond the middle. Marginal cell nearly as long as stigma, with the apical truncation rather strongly oblique and with the substigmatal and poststigmatal parts about equal. Second submarginal cell very broad below, narrowed about two-thirds above and receiving the recurrent veins at a considerable and equal distance from base and apex. Discoidal and second recurrent veins very faint. Claws moderately large, strongly curved, and rather deeply cleft with the inner tooth a little shorter than the outer.

Face below antennæ smooth, shining and with very sparse, fine, shallow punctures. Frons and vertex very minutely granular tessellate, impunctate and opaque. Cheeks and thorax finely and rather delicately tessellate and shining, the cheeks and pleura with indistinct minute punctures, the mesoscutum with similar very sparse punctures. Metanotum and disk of propodeum somewhat duller than rest of thorax, the middle of the latter toward base having a coarser and distinctly roughened sculpture. Abdomen microscopically lineolate and shining, except in a subapical band on first three tergites where the lineolations are very dense and the surface duller. Pubescence fine and whitish, rather dense and moderately long on cheeks, front coxæ and sternum. Mesopleura nearly bare but the pubescence probably denuded. Mesoscutum with fine short hairs anteriorly and apparently nude on the disk (the specimen is pinned through the mesoscutum). Face below antennæ with sparse, short, inconspicuous hair but with a small patch of fine short hair on outer side of each antennal socket. Frons otherwise entirely nude. Vertex with a few short hairs behind the ocellar region.

Head and thorax very dark greenish blue. Mandibles, except reddish tips, labrum and entire face below level of antennæ creamy white or pale yellow-

ish (discolored in type), with the dorsal margin of the pale color transverse and almost straight, except that there is a very short angular projection upward on each side at the orbits. Cheeks entirely dark. Tubercles pale yellow or whitish, the thorax otherwise entirely dark. Abdomen piceous above and beneath with the apex of seventh tergite testaceous. Tergites 1 to 5 with pale markings, somewhat reddened by cyanide in type, but probably pale yellow or creamy white in life. Tergite 1 with two oval transverse spots, narrowly separated medially, well separated from lateral margins, and placed a little beyond the middle and not subapical as usual in other species of *Perdita*. Tergite 2 with two transverse basal spots, moderately well separated medially and about as far distant at outer ends from lateral margins as their distance apart. Tergite 3 with a transverse mark on each side at base, more nubilous than on 2, more widely separated medially, oblique at sides and reaching to lateral margins. Tergite 4 and 5 with traces of a small pale spot on the lateral margins. Labio-maxillary structure piceous. Antennæ piceous, with the scape broadly whitish beneath, but with the pedicel and flagellum entirely dark, except that the first two joints of the flagellum are slightly yellowish beneath. Tegulæ hyaline with a pale yellow or creamy base. Wings hyaline, faintly tinted with fuscous, with the margins of stigma and veins, except the obsolete discoidal and second recurrent veins, fuscous, the stigma otherwise pallid.

Type in the collection of the State Agricultural College, Fort Collins, Colorado.

5. **Perdita swenki** Crawford.

1 ♀, Chicago, Illinois (Shelford). From the Urbana collection.

This differs from typical *P. swenki* in having small lunate yellow marks below antennal sockets on the dog-ear plates, and in having the abdominal bands not interrupted medially except on tergites 1 and 2.

6. **Perdita lasiogastra**, new species.

1 ♂ (holotype), Katherine, Texas, Dec. 3, 1911, in sand hills on undetermined flower.

This runs in Cockerell's table (1896) to *Perdita sphæralceæ*, var. *alticola* Cockerell (couplet 32) but is more robust, with head not much wider than long, the yellow of face extending above antennal sockets in median line, the mesonotum dull and strongly tessellate, etc. From *P. hirsuta* Cockerell it differs in having

the head less rounded and somewhat wider than long, the frons and mesonotum moderately hairy, the yellow bands on abdomen not reaching to lateral margins except on first segment, etc. It is closely allied to *P. nebrascensis* Swenk and Cockerell, and *P. swenki* Crawford, differing from the former in having sparser and longer hair on the mesonotum, the first joint of labial palpi very much shorter (hardly one and one-half times longer than following joints instead of about three times), the head and thorax very dark green, inclining to bluish green, instead of brassy green, etc. From *P. swenki* it differs in having the dark color of frons descending at an angle to the antennal sockets, the yellow bands of abdomen much wider, with a strong tendency to become wider at middle instead of at sides, the abdomen sparsely but distinctly hairy above except on first two segments, the first joint of labial palpi shorter, the third discoidal cell more distinct, etc.

MALE: General form a little more robust than usual, or about as in other species of the *octomaculata* group. Head a little wider than long, considerably wider than thorax, gently rounded at the sides and more transverse above. Cheeks broad but simple. Eyes about twice as long as wide, with the inner orbits parallel and slightly and broadly emarginate above the middle. Mandibles moderately curved, tapering, rather acute and simple at apex, and reaching approximately to far margin of labrum. Clypeus projecting a little in front of ocular line and somewhat convex; the disk hardly wider than long, subtruncate above between dog-ear plates, with the sides rounded out above the middle and then suddenly diverging much more rapidly at a point opposite the clypeal dots; the lateral extensions consequently very broad at inner ends, gradually narrowing outward and abruptly narrowed to a slender point close to base of mandibles; their anterior margin broadly reflexed, but their surface nevertheless visible to a large extent in frontal view of head. Dog-ear plates about one-half longer than wide and pointed below. Supraclypeal plate as long, when measured to anterior margin of antennal sockets, as wide. Lateral plates of face considerably widened below, and opposite middle of dog-ear plates each covering slightly less than one-third the total width of face. Antennæ ordinary, with the joints of flagellum about as long as thick. Prominence between antennæ broad and very low. Frons with an obscure median smooth line extending its whole length, and the vertex with a similar but more distinct median line. Abdomen rather narrowly ovate, about twice as long as wide, convex, and with the apex only slightly reflexed toward venter. Seventh tergite broad at base and with a rather narrow produced apex which is obtuse at end.

Membrane of wings densely covered all over with very fine, short setæ. Stigma narrowly lanceolate, a little shorter than first submarginal cell and emitting radius a little beyond the middle. Marginal cell somewhat shorter than stigma, with the apical truncation rather oblique and with the substigmatal and poststigmatal parts about equal. Second submarginal cell narrowed nearly two-thirds above. Recurrent veins exactly interstitial with the intercubiti, the second recurrent and subdiscoidal veins distinct although thinner than the other veins.

Frons, vertex and mesonotum strongly tessellate and dull, yet somewhat shining in some aspects. Cheeks, pleura and propodeum not quite as dull as mesonotum, yet strongly tessellate. Face below antennæ smooth, but the tessellation of frons descends on lateral plates to a point a little below the antennal sockets. Punctures of cheeks, pleura and mesonotum numerous but well separated and very fine and obscure, those of frons very obscure. Clypeus and sides of face with sparse, fine, shallow punctures. Abdomen shining and with the usual microscopic sculpture. Pubescence fine, whitish, moderately dense and long on cheeks and pleura, and somewhat shorter and thinner on mesonotum and frons. Face below antennæ with short sparse hairs. Abdomen above with short subappressed hair except on the first two segments, that on third segment thin, and on following segments becoming denser and longer toward apex, that on the last two segments having the usual length and density. Hair of legs rather dense and that on hind tibiæ and tarsi long.

Head and thorax very dark bluish green, the pleura and propodeum slightly bluer. Mandibles except reddish apices, labrum, mark on cheeks, and face below antennæ light lemon yellow, the pale color extending above antennal sockets at sides and in median line. At the sides the yellow extends obliquely from the sockets to foveæ and encloses about one-half of the latter, but the line of demarkation very uneven. At the middle of frons the yellow forms a short spearhead-shaped mark, much broader than high and reaches just to level of foveæ. Dog-ear plates each with a small black spot at lower end. Mark on cheeks broad next to mandibles and extending rather narrowly along orbits to middle of eyes. Entire margin of prothorax and tubercles yellow, except a brief interruption at middle of hind margin of pronotum, and a subhyaline dark streak extending from the dark area on each pleuron to the tubercle. Abdomen yellow beneath and brownish piceous above with seventh tergite yellowish brown. Tergites 1 to 6 with a broad yellow band. Band on 1 subapical, narrow at outer ends where it joins the yellow of venter, narrowly interrupted medially, and each half with a large, oval, inner expansion, truncate at end. Bands on following segments basal, that on 2 broad and even and not quite reaching to lateral margins. Those on following segments successively somewhat narrower, narrowed toward the sides but not at all oblique, and ending considerably farther from lateral margins than that on 2. That on 3 about as wide at middle as that on 2. Narrow, depressed apical margin of tergites 2 to 6 pale brownish yellow,

with the intervening piceous band on 2 and the middle of that on 3 hardly wider than the depressed margin. Legs yellow, but a large blotch on front and middle femora behind, a blotch on front tibiæ behind on apical half, middle and hind coxæ except apex, hind femora except base, apex, and stripe on dorsal margin, and hind tibiæ except base and under side, dark brown, and the hind tarsi somewhat paler brown. Maxillæ and palpi piceous, but the labium and glossa yellowish. Scape entirely yellow, the pedicel and flagellum piceous above and rather broadly dull yellow beneath. Tegulæ hyaline, with a yellow spot at base. Wings slightly milky hyaline, faintly tinted with fuscous; the veins moderately dark brown, with subcosta, margins of stigma and veins of marginal cell a little darker, the stigma centrally pallid.

Length about 5.0 mm.

Type in collection of the Illinois State Natural History Survey, Urbana, Illinois.

7. **Perdita sexmaculata** Cockerell.

1 ♂, Mission, Texas, Dec. 5, 1910. In collection of Illinois State Natural History Survey.

This agrees well with the description of the male given by Cockerell and Porter, 1899, and shows much similarity to a female received from Dr. Cockerell, but I note some differences. Front and middle femora entirely black behind except at apex, and hind femora black except narrowly at apex and a rather broad yellow stripe beneath. Dot at apex of scape above, dorsal side of pedicel and a mark at base of funicle joints 2 to 4 above, pale brownish fuscous. Yellow on frons extending obliquely from dorsal edge of antennal sockets to middle of foveæ, the yellow notched by the foveæ and extending linearly between orbits and foveæ to the middle of the latter. Abdomen deep black, with a creamy white spot on each side of tergites 2 to 5, triangular on 2, oval on the others, and decreasing in size on successive segments, the last pair being very small. Frons strongly but finely tessellate and rather dull, with scattered fine punctures. Mesonotum shining but with a distinct, although delicate, tessellation, and sparsely and very finely punctured. Abdomen oval, convex above and beneath, with only the last segment recurved toward venter. Seventh tergite narrowed from base to a shortly produced, moderately narrow and truncate apex. Maxillary palpi four-jointed.

This species I place in a group by itself, although it is closely allied to the *octomaculata* group. It is the type of the subgenus *Tetraperdita* Cockerell and Porter.

8. Perdita gerhardi arenicola, new subspecies.

13 ♀, 12 ♂ (holotype ♀, allotype and paratypes), sand pit, Meredosia, Illinois, Aug. 19, 1913, and Aug. 20, 1917.

1 ♀ (paratype) Devil's neck, Topeka, Illinois, Aug. 17, 1907.

1 ♀, 3 ♂ (paratypes), bluff sand, Arenzville, Illinois, Aug. 14, 1913.

1 ♂ (paratype), Devil's hole, Havana, Illinois, Aug. 18, 1912.

FEMALE: Differs from typical *Perdita gerhardi* Viereck, from East Chicago, Indiana, in having the head, thorax and legs maculated as follows: Dark green spots on the frons enlarged, contiguous to the black fovea on each side, extending somewhat obliquely to the lateral ocelli but not uniting in median line, so that there is a median yellow vitta extending from the pale color of face to the median ocellus. Ocelli enclosed by a dark green transverse band, more or less jagged and irregular, coalescing anteriorly between median and each lateral ocellus with the dark frontal spots, and extending laterally to the eye margins. Yellow of frons extending upward between foveæ and eyes, expanding above the foveæ on each side and sending a small pointed projection obliquely to the outer margin of the lateral ocelli. In front of each lateral ocellus there is usually a yellow dot enclosed in the dark area. Occiput with a dark green band above level of neck, extending more narrowly and more or less distinctly laterad on to the cheeks to the posterior eye margin. The yellow interval on the vertex behind ocelli in typical *arenicola* broken on each side by an oblique connection between the dark band of vertex and that of occiput. Prothorax with an oblique blackish line on each pleuron, extending somewhat on to the tubercle. Mesoscutum with an elongate cuneate dark green vitta on each side, pointed behind where it touches the axillæ on each side of the base of scutellum, and rounded at anterior end where it does not quite reach to the anterior margin of sclerite. Inner margin of cuneate marks nearly straight, parallel and widely separated, and exteriorly the marks are separated from lateral margins of scutum by a yellow interval, narrow posteriorly but widened in front of tegulæ. Suture between pro- and mesonotum darkened, with the dark line becoming more or less expanded medially on the scutum. Sutures between the scutum, scutellum and metanotum also more or less darkened. Legs with a more or less distinct brown blotch posteriorly on front and middle femora and tibiæ and hind femora, besides the usual markings of typical *gerhardi* on the hind tibiæ and tarsi. Brown band on hind margin of tergites 1 to 4 darker and wider than in typical *gerhardi*.

Length about 5.0–5.5 mm.

MALE: The dark green dots on frons of typical *gerhardi* enlarged and extending obliquely upward and inward to each side of median ocellus. Lateral ocelli enclosed by a transverse dark green band, which at most reaches about two-thirds of the distance from ocelli to the eye margin, and just touches but does not enclose the median ocellus. Sometimes the ocellar band and frontal spots are joined by a slender dark isthmus between each lateral ocellus and the median ocellus. In some specimens the frontal spots are much smaller and the ocellar band does not extend laterally beyond the ocelli. Occiput with a dark blotch above the neck, but the dark area does not extend outward on to the cheeks. Prothorax immaculate. Mesoscutum as in the female, except that the suture between it and prothorax is not darkened. Thorax otherwise as in the female, except that in some specimens (five out of sixteen) a basal band on scutellum expanding at sides, a transverse band on metanotum leaving apical half of that sclerite yellow, and an oval spot on each side of disk of propodeum at lateral margins, are dark green. Legs as in the female. Abdomen with a narrow brown apical band on tergites 1 to 5, generally more distinct than in the female of typical *gerhardi*.

Length about 4.0–4.5 mm.

Types in the collection of the Illinois State Natural History Survey, Urbana, Illinois.

The males of *arenicola* seem to be less variable than the females as only one specimen has the cuneate vittæ of mesoscutum only partially developed. In case of the females three specimens from Meredosia and one from Arenzville are almost typical *gerhardi*, but have the frontal spots more or less joined to the black foveæ and the cuneate marks of mesoscutum are indicated by a very faint brownish suffusion. Six other females from Meredosia have the cuneate marks more distinctly indicated, yet more or less nubilous and broken, and brown instead of dark green.

Although the males on the whole are more constant than the females, nevertheless one male from Havana, Illinois, taken with a typical male of *arenicola* is very different and practically has the coloration of *Perdita monardæ* Viereck. Having examined specimens of *monardæ* at Washington and Philadelphia I can affirm positively that it is identical in structure with *gerhardi* and evidently only an eastern race which should be cited as *P. gerhardi monardæ*. The Havana specimen of *monardæ* is

evidently only an extreme individual variation of *arenicola*, but in New Jersey *monardæ* has become a well stabilized race.

I would place *P. gerhardi* and its subspecies *arenicola* and *monardæ* in a group by themselves, and I know of no other species very closely allied, although in a general way *gerhardi* is allied to the *octomaculata* group.

9. **Perdita maculipennis** Graenicher, and var. **bilineata**, new variety.

32 ♀, 20 ♂, on willow, Oregon, Illinois, June 21, 1917.

2 ♀, Savanna, Illinois, July 26, 1892 (one bears four Asclepias pollen-masses attached to legs).

1 ♀, on bluff, Wittenberg, Missouri, July 12, 1909.

This species is variable in the extent of the yellow markings and it is possible, when material is known from intervening regions, that it may prove to intergrade with *Perdita maculigera* Cockerell from New Mexico, and the new variety *bilineata* is in fact a distinct lead toward *maculigera*.

The females from Oregon, Illinois, agree closely with Graenicher's description but usually have the pronotum dark without yellow spots. In one specimen there is a slight trace of two yellow longitudinal lines on mesoscutum. The males from the same locality also agree with the original description, but many of them have an additional small yellow spot on mesopleura just behind the tubercles and the yellow band across the anterior part of mesosternum often extends on to the pleuron on each side. The mesonotum is either entirely dark or the lateral margins of the scutum may show a small yellow spot anteriorly, and more rarely there may be two thin yellow longitudinal lines on disk of scutum and a similar yellow line on lateral margins.

The female from Wittenberg, Missouri (holotype of variety *bilineata*), has two large yellow spots on hind margin of pronotum and two distinct discal longitudinal yellow lines on the mesoscutum. These lines reach almost to the anterior margin and are triangularly and transversely enlarged on the posterior margin of scutum. The yellow bands on the abdomen in this specimen are larger than in typical *maculipennis*, being narrowly interrupted in the middle and becoming oblique at sides and

reaching almost or quite to lateral margins on tergites 2 to 4. The two specimens from Savanna, Illinois (paratypes of *bilineata*), agree closely with the Wittenberg specimen, except that the two lines on the mesoscutum are less distinct.

The variety *bilineata* indicated in some of the specimens from Oregon, Illinois, seem somewhat better stabilized at Savanna and still more so at Wittenberg, Missouri. It is possible that *bilineata* should rank as a race at Wittenberg, but of this it is impossible to affirm one way or the other on the basis of a single specimen.

Types of *bilineata* are in the collection of the State Natural History Survey, Urbana, Illinois.

Perdita maculigera Cockerell and *P. maculipennis* Graenicher form a small group of *Perdita* that is distinct in many ways, but coming nearest to the *perpallida* group in the great *octomaculata* complex of groups.

10. Perdita maura Cockerell.

1 ♀, Urbana, Illinois, July 16, 1892; 1 ♀, Algonquin, Illinois, Sept. 10, 1896; 1 ♀, Carlinville, Illinois.

P. maura forms another group of the *octomaculata* complex. On account of the peculiar palpi Robertson has placed it in a genus by itself under the name of *Zaperdita*, which I at present regard as only of subgeneric importance. The maxillary palpi are very short and composed of only two joints.

11. Perdita mentzeliæ Cockerell.

1 ♂, Santa Fe, New Mexico, August, on *Mentzelia* (Cockerell) in the collection of the State Natural History Survey, Urbana, Ill.

1 ♂, Antonito, Colorado, Aug. 5, 1899, in the collection of the State Agricultural College, Fort Collins, Colorado.

P. mentzeliæ may be considered the type of a small group of the *octomaculata* complex.

12. Perdita eriogoni Cockerell.

1 ♂, Westlake, Colorado, July 8, 1900, and 1 ♂, Livermore, Colorado, July 15, 1900, in the collection of the State Agricultural College, Fort Collins, Colorado.

P. eriogoni is a member of the *californica group* which reaches its greatest development on the Pacific coast. The *californica* group also belongs to the *octomaculata* complex.

13. **Perdita stottleri** Cockerell.

1 ♂, Fort Collins, Colorado, Aug. 25, 1900, in collection of the State Agricultural College.

This and the following species belong to the *zebrata* group.

14. **Perdita fraterna**, new species.

1 ♂ (holotype), "Colo. 1414" and 1 ♂ (paratype), "Colo. 1742," with head missing. These specimens were apparently collected by C. F. Baker.

This species is nearly identical with *Perdita stottleri* Cockerell in external characters but is quite distinct in the genitalia. The coloration and markings are nearly alike but I notice the following differences, although the markings may be subject to some variation in both species. The lateral marks of the frons in *fraterna* extend from the middle, or below the middle, of the outer margin of antennal sockets to a point on orbits just below the foveæ. In *stottleri* they extend from the dorsal end of sockets to a point on orbits level with middle of foveæ, and consequently they are longer, broader and form a much less acute angle with the orbits than in *fraterna*. In *fraterna* the first tergite is either entirely piceous or shows only a trace of a subapical yellow band. In *stottleri* the yellow subapical band is rather broad, narrowly interrupted medially and reaches to lateral margins. There is also a dark band at juncture of tergites 5 and 6 in *fraterna*, which is absent in *stottleri*. In *fraterna* the front femora and tibiæ and middle tibiæ have a more or less distinct brown blotch behind, while in *stottleri* the legs are entirely yellow except on the hind tibiæ above toward apex. The wing veins and margins of stigma are also distinctly darker brown in *fraterna* than in *stottleri*. In size and sculpture the two species are exactly alike except that the mesonotum is highly polished in *fraterna*, and tessellate and a little duller in *stottleri*.

MALE: Head not enlarged, distinctly wider than long, somewhat wider than thorax and well rounded on sides and above. Cheeks narrow and sim-

ple. Clypeus projecting for about one-half its length in front of ocular line; its disk convex, about one-half wider than high and rather broadly truncate above between dog-ear plates; the lateral extensions short, broad, and broadly reflexed anteriorly so that they are visible only in small part in frontal view of head. Dog-ear plates nearly twice as high as wide and obliquely narrowed to a point below. Supraclypeal plate about one-half broader than high (in *P. stottleri* from Fort Collins it is quadrate, but in *P. stottleri flavida* S. & C. from Nebraska it is nearly as transverse as in *fraterna*). Lateral plates of face somewhat widened below, and each covering somewhat less than one-fourth the total width of face at level of dog-ear plates. Prominence between antennæ short, but strongly tectiform and carinate, and hardly extending on to frons. Frons with a smooth median impressed line, which becomes much more distinctly impressed close to the median ocellus. Mandibles simple, gently curved, tapering to acute apex and reaching almost to far margin of labrum. Abdomen oval, about twice as long as wide and gently recurved toward venter at apex. Seventh tergite gradually narrowing to the broadly rounded apex. Membrane of wings beyond venation provided with sparse, very fine, short setæ. Stigma narrowly lanceolate, a little shorter than first submarginal cell and emitting radius slightly beyond the middle. Marginal cell about as long as, and distinctly wider than the stigma, with the substigmatal and poststigmatal parts nearly equal, the apical truncation nearly square and about one-half as broad as length of metacarpus. Second submarginal cell narrowed one-half to two-thirds above and receiving the recurrent veins interstitially, or nearly so, with the intercubiti. Subdiscoidal vein and second recurrent, except a short stub, obsolete. Claws rather large, strongly bent and deeply cleft, with the inner tooth somewhat shorter than the outer.

Face below antennæ smooth and shining, the clypeus with sparse fine punctures, and the dog-ear and lateral plates with finer punctures. Frons and vertex densely granular tessellate, rather dull and obscurely punctured. Cheeks shining, finely tessellate and punctured. Mesothorax including the pleura polished and shining, with the puncturation fine and sparse on scutum and rather closer on pleura. Disk of propodeum distinctly tessellate and the metapleura lineato-reticulate. Abdomen with the usual microscopic sculpture. Pubescence white, fine, rather dense and long on cheeks, pleura, metanotum and sides of propodeum, and somewhat shorter and moderately abundant on face, vertex, occiput and mesonotum.

Head and thorax dark green, becoming slightly bluish on propodeum and having a brassy luster on mesothorax. Mandibles, except reddish tips, labrum, entire face below antennæ and marks on cheeks, yellow (reddened by cyanide in types). Yellow of face extending obliquely upward on each side from middle of antennal sockets on outer side to a point on orbits slightly below the foveæ. Mark on cheeks in form of a transverse band next to base of mandibles, produced in a thin line along orbits for a short distance. Tubercles, cuneate marks on each side of hind margin of pro-

notum (uniting with yellow of tubercles in paratype) and anterior margin of prothorax, broadly interrupted on each side, yellow. Thorax otherwise dark. Abdomen yellow, banded above with piceous. First tergite entirely dark, but showing a slight trace of a subapical yellow band in paratype. Basal margin of tergite 2, widened at sides, and a band covering contiguous margins of tergites 2–3 to 5–6, piceous. Yellow intervals on tergites 2 and 3 about as wide as the dark bands and a little oblique at sides. Yellow interval on the next two tergites somewhat wider than the dark bands. Dark band at juncture of tergites 5–6 paler than the others, especially in paratype. (In *P. stottleri* there are four dark bands as in *fraterna,* but the first one is at the juncture of tergites 1–2 and there is none on tergites 5–6. The dark bands also tend to end a considerable distance from lateral margins, especially on the more apical segments, which is not the case in *fraterna.*) Legs yellow, with hind tibiæ above infuscated and hind tarsi above slightly darkened. In holotype (and to a less extent in paratype) there is a fuscous blotch on posterior side of front femora and of front and middle tibiæ. Maxillæ piceous but labium and palpi yellowish. Antennæ yellow, with apex of scape, pedicel and flagellum above not very broadly infuscated. Tegulæ hyaline, with a yellow spot at base. Wings clear hyaline, the veins and margins of stigma moderately dark brown, with subcosta a little darker, and the stigma otherwise paler.

Length about 5.0 mm.

Holotype in the collection of the Illinois State Natural History Survey, Urbana, Illinois; paratype in the collection of the State Agricultural College, Fort Collins, Colorado.

15. Perdita pratti Cockerell.

1 ♀, Katherine, Texas, Dec. 3, 1911, in the collection of the Illinois State Natural History Survey, Urbana, Illinois.

This species belongs to the *ignota* group.

UNICELLULAR GLANDS IN THE LARVÆ OF ERISTALIS TENAX

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INTRODUCTION

There occur in certain insects some very remarkable unicellular glands which have aroused the interest of various investigators. These glands were described by Leydig (1859) in several insects. Batelli (1879) who first observed them in *Eristalis tenax* made some accurate observations on their structure in fairly mature larvæ, but his observations were not complete. He maintains that they "form an apparatus adapted to the state and functions of the respiratory tube." Viallanes (1885) maintains that they are a new type of elastic tissue forming the mechanism by which the tail is shortened. Gazagnaire (1886) ridicules Viallanes' views and contends that the function of the glands is to furnish an oiling fluid for the lubrification of the breathing tube. Wahl (1889) accurately described the glands in rather old larvæ of *Eristalis* and maintains that they furnish a secretion which oils the tip of the tail, thus preventing water from adhering to the end of the respiratory tube and from entering it. His conclusion that the secretion is of an oily nature is based entirely upon its optical properties.

According to Wahl, similar glands are found in rather mature larvæ in connection with other respiratory tubes in the anterior end of the larvæ. He concludes that these anterior glands form an oily secretion which aids the insects in remaining at the surface of the liquid in which they live.

Krüger (1926) described similar gland cells in *Syritta,* a fly closely related to *Eristalis.* According to Krüger, similar cells have been found in many Muscidæ, for example in *Polietes lardaria* (Fabr.) by G. W. Müller, which secrete carbon dioxide, thus playing a rôle in respiration.

[1] The junior author participated in this work while an Honors Student in the University of Buffalo.

Giacomini (1900), who observed these gland cells in larvæ of various ages, accepts Wahl's view as to their function but thinks that they probably have another more important function, perhaps that of protecting with a bactericidal action the opening of the respiratory tubes from the invasion of microorganisms.

Because of the diversity of views concerning the structure and function of these glands, and since no previous investigator has described them fully in very young larvæ of *Eristalis tenax,* a study was made of them.

MATERIAL AND METHODS

The larvæ were obtained as follows. Adult female flies were collected in July and August in Woods Hole. At this season they are very abundant, feeding upon various flowers. The flies were brought into the laboratory and kept in small wire cages. They were fed on cane sugar and water was constantly available to them. During this season many female flies contain numerous fertilized eggs. When kept under the above conditions they frequently deposit a mass of eggs within a few hours after they are brought in. The eggs were removed from the floor of the cage and placed on the surface of tap water in a finger bowl. After about twenty-four hours the eggs hatch and the larvæ collect on the side of the dish nearest the light. They are highly positive to light for a few hours and then become highly negative.

Those larvæ which were to be kept alive were transferred within a few hours to a jar containing human feces. In this they lived well up to the time of pupation. As is well known, the larvæ of *Eristalis* are commonly called rat-tailed larvæ. Their posterior end is much extended in the form of a long tail-like structure. Opening at the end of this structure are two large tracheæ. The larvæ keep the ends of their tails above the surface of the liquid as they move around in the material upon which the feed.

Those larvæ which were used in the present work were removed from the water about twenty-four hours after hatching. They were placed upon a slide, covered with a few drops of fixing solution, and pressed flat with another slide. After they had been

killed in the flattened condition they were removed to a bottle of the fixing solution for a short time and then preserved in alcohol. Three fixing solutions were used: Bouin's, Flemming's, and Carnoy's. The last proved useless because of the distortion it produced.

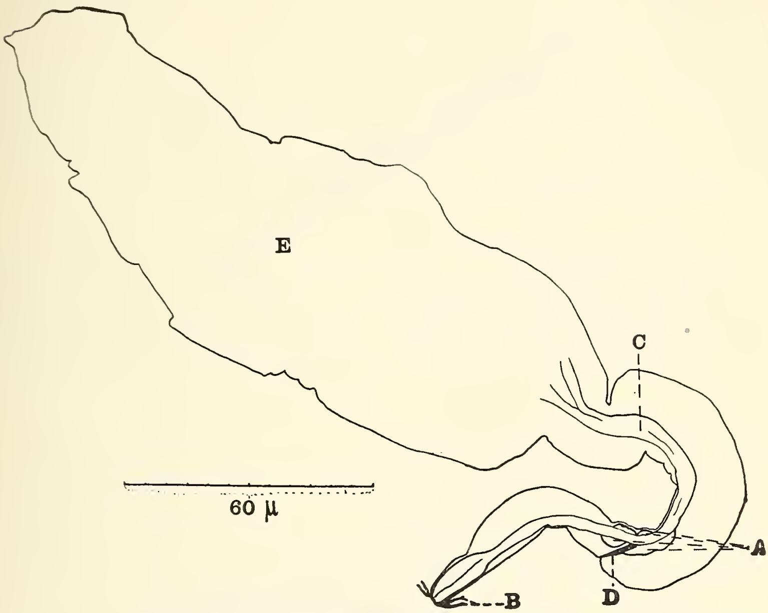

FIGURE 1. *Camera lucida* outline of a larva of *Eristalis tenax* about 24 hours old. E, body; C, tracheæ in tail; A, unicellular gland cells; D. muscle fibers; B, filaments at end of tail.

Larvæ of the age described above are highly transparent in the living condition and, when stained and mounted *in toto*, make beautiful preparations.

STRUCTURE OF THE GLANDS

Figure 1 is a *camera lucida* outline of one of these larvæ. As is shown in this figure, there are located in the tail a number of unicellular glands closely attached to the respiratory tube. The gland cells are 6 in number in larvæ of this age. As is shown in

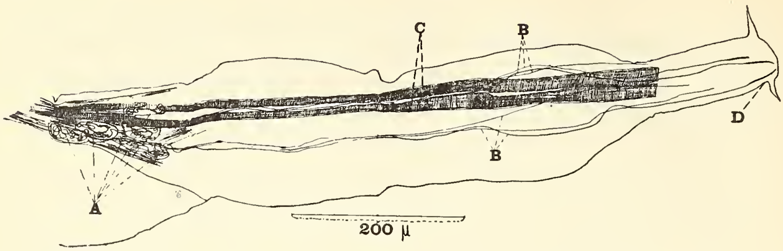

FIGURE 2. *Camera lucida* drawing of part of the tail of a larva of *Eristalis tenax* about 24 hours old. A, unicellular glands, in each of which is a much convoluted canal containing the secretion stained black with Flemming's fixative; B, secretion in cavities of protoplasmic threads of unicellular glands; C, tracheæ in tail of larva; D, posterior end of tail.

figures 2 and 3, from each gland cell there extends a very thin, long, thread-like protoplasmic process to the end of the tail. The preparation from which figure 2 was drawn did not show the end of the tail clearly, but this was shown beautifully in the

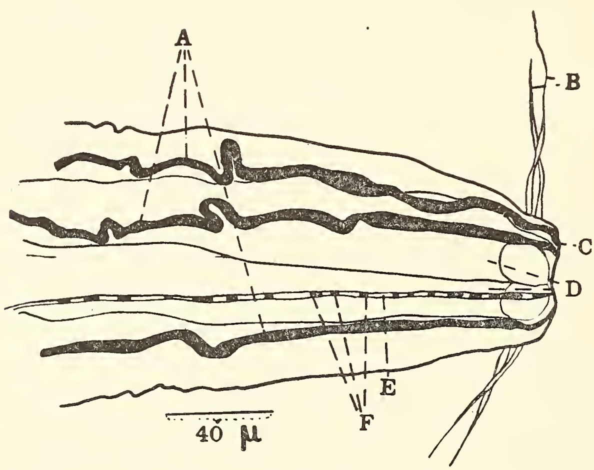

FIGURE 3. *Camera lucida* drawing of posterior end of larva of *Eristalis tenax* about 24 hours old. D, tracheæ in tail; B, filaments at end of tail; A, secretion in canals of protoplasmic threads of unicellular glands stained black with Flemming's fixative; F, droplets of secretion in canal in protoplasmic thread of gland cell; E, canal in protoplasmic thread of unicellular gland; C, location of external opening of hollow protoplasmic thread of gland cell.

preparation from which figure 3 was drawn. The protoplasmic process contains a minute cavity which extends from end to end and continues into the cell body where it forms a convoluted tubule in the cytoplasm of the cell. (Fig. 5, C.) This canal apparently does not come in contact with the large nucleus shown in figure 6.

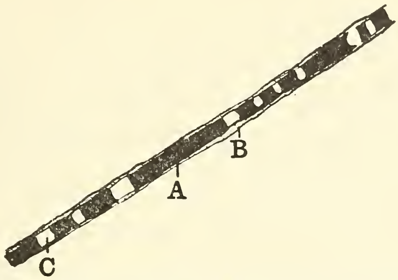

FIGURE 4. *Camera lucida* drawing of portion of protoplasmic thread of unicellular gland fixed in Flemming's fixative. ×1900. C, canal in thread; B, wall of hollow thread; A, secretion of gland cells broken up into droplets in the canal and stained black with Flemming's fixative.

As stated above, according to Wahl, similar cells occur in the anterior ends of fairly mature larvæ in connection with two respiratory tubes located in this region. At the age of about twenty-four hours neither of these two respiratory tubes nor their associated gland cells have yet developed in the anterior end of the larvæ.

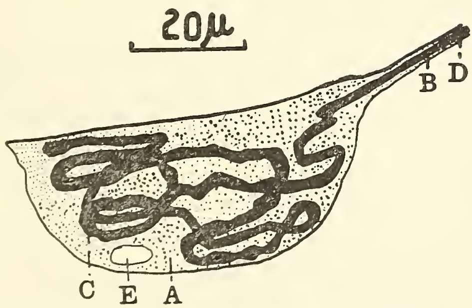

FIGURE 5. *Camera lucida* drawing of unicellular gland from the tail of a larva of *Eristalis tenax* fixed in Flemming's fixative. A, cytoplasm of cell; B, wall of hollow protoplasmic thread; C, secretion of gland cell stained black with Flemming's fixative in convoluted canal in gland cell; D, secretion in canal in protoplasmic thread of gland cell; E, vacuole.

NATURE OF THE SECRETION OF THE GLANDS

The secretion of these unicellular glands is an oily liquid which flows out at the end of the tail. That it is a liquid is conclusively proved by the fact that frequently the secretion is seen broken up in drops in the cavity of the protoplasmic processes of the cells (Fig. 3, F and Fig. 4, A).

That it consists certainly in part of a fatty substance is shown by the fact that in larvæ fixed in Flemming's fixative the secretion is stained a dense black. Figures 1–5 were drawn from larvæ fixed in Flemming's fixative and mounted without further staining. In these larvæ the secretion in the protoplasmic processes of the gland cells frequently resembles a minute black thread. It is easy to understand how Viallanes was misled in maintaining that it is a solid fiber. In larvæ fixed in Carnoy's or in Bouin's fixative it is very difficult to distinguish the unstained protoplasmic processes. However, in one preparation fixed in Bouin's fixative and stained in Delafield's hæmatoxylin clear outlines of the convoluted canal in the cytoplasm of the cell were beautifully shown.

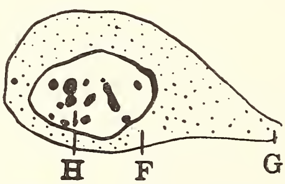

FIGURE 6. *Camera lucida* drawing of a gland cell from the tail of larva of *Eristalis tenax* fixed in Bouin's fixative and stained in Haidenhain's iron alum hæmatoxylin. ×1900. H, nucleus; F, cytoplasm; G, anterior end of protoplasmic process.

THE FUNCTION OF THE SECRETION

The function of the glands is not to form a lubricating material for the respiratory tube, as Gazagnaire maintains, because the external opening of the glands is not in the proper position for this. It is not to furnish a mechanism for shortening the respiratory tube, as Viallanes maintains, because it is not of the

structure necessary. No evidence was found in favor of the views that the secretion plays a rôle in respiration or that it exerts a bactericidal action. The function of the glands is probably to furnish an oily secretion which prevents water from entering the end of the respiratory tube and aids in maintaining the end of the tail at the surface of the liquid material in which the larvæ live, as Wahl suggests.

SUMMARY

1. There occur in the tails of larvæ of *Eristalis tenax* about twenty-four hours old 6 unicellular glands.

2. These glands have very long thin tubular protoplasmic processes which extend to the end of the tail.

3. The cavity of the process continues into the cytoplasm of the cell in the form of a very much convoluted tubule.

4. The secretion of these glands is in part at least of a fatty nature.

5. The function of this secretion is probably to oil the end of the respiratory tube, thus preventing the entrance of water and aiding in supporting the end of the tail at the surface of the liquid in which the larvæ live.

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A SUPPLEMENT TO THE INDICES TO THE KEYS TO AND LOCAL LISTS OF NEARCTIC COLEOPTERA[1]

BY MELVILLE H. HATCH

In its arrangement the present supplement follows the general plan of the two indices[2] already published by the author, to which reference should be made for explanations. For corrections and additions the author is indebted to Mr. A. B. Wolcott, E. Wasmann, S. J., and Mr. Henry Dietrich, and he will appreciate having further errors and omissions called to his attention.

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[1] A contribution from the Zoological Laboratory of the University of Washington.

[2] A Systematic Index to the Keys for the Determination of the Nearctic Coleoptera, JR. N. Y. ENT. SOC. XXXV, 1927, p. 279–306.

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DYTISCIDÆ: Sharp, Sci. Tr. Roy. Dublin Soc. (2), II, 1882, p. 179 (genera and groups of species; species not keyed). **Hydrocanthus** Zimmerman, Wien. Ent. Zeit. XLIV, 1928, p. 167–170. **Bidessus** Hatch, Bull. Brook. Ent. Soc. XXIII, 1928, p. 217. **Hydroporus** Gellermann, Pan-P. Ent. V, 1928, p. 63 (*mellitus* group). **Ilybius** Fall, Ent. News, XXXVIII, 1927, p. 284. **Copelatus** Schaeffer, Jr. N. Y. Ent. Soc. XVI, 1908, p. 17. **Rhantus** Hatch, Bull. Brook. Ent. Soc. XXIII, 1928, p. 222. **Colymbetes** Hatch, l. c., p. 224. **Dytiscus** Hatch, l. c., p. 226. **Graphoderes** Hatch, l. c., p. 227.

HYDROPHILIDÆ Schiodte, De Metamor. Eleut. Obs. 1861, p. 30 (genera of larvæ). **Helochares-Helocombus, Helobata** Winters, Pan-P. Ent. IV, 1927, p. 19–29. **Sphæridiinæ** Knisch, Arch. Naturg. LXXXV, 1927, A, 1920, p. 71 (genera).

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Oxytelinæ: **Pseudopsis** Strohmeyer, Ent. Blätt. VII, 1911, p. 102. **Holotrochus** Chapin, Proc. Ent. Soc. Wash. XXX, 1928, p. 65.

Aleocharinæ: **Liparocephali** Chamberlin & Ferris, Pan-P. Ent. V, 1929, p. 142–143 (genera, sp. of *Liparocephalus*). **Xenodusa** Wasmann, Deut. Ent. Zeit. 1897, p. 273.

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CLAVIGERIDÆ: **Adranes** Wickham, Can. Ent. XXXIII, 1901, p. 25.

HISTERIDÆ Germain, Nat. Can. XLIII, 1916, p. 125–128, 136–138 (Que.). **Hololepta** Desbordes, Bull. Soc. Ent. Fr. 1928, p. 54 (*Leionota, Iliotona*; overlooks work of Schaeffer and Carnochan). **Hister** Hatch, Can. Ent. LXI, 1929, p. 76 (*interruptus* group), p. 77 (*nubilus-pollutus* group of subg. *Atholus*). **Epierus** Bickhardt, Ent. Blätt. XVI, 1920, p. 174 (*planulus* group). **Saprinus** Hatch, Can. Ent. LXI, 1929, p. 77–79 (*lugens* group), p. 79 (*rugifrons-patruelis* group of subg. *Hypocaccus*).

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MELYRIDÆ: **Temnopsophus** Hatch, Ann. Ent. Soc. Am. XX, 1927, p. 366. **Trichochrous** Tanner, l. c., XXI, 1928, p. 273 (part). **Listrus** Blaisdell, Pan-P. Ent. V, 1928, p. 38 (*annulatus* group). **Dasytes** Blaisdell, Ent. News XVII, 1906, p. 76 (*hudsonicus* group).

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ENDOMYCHIDÆ: **Mycetina** Fall, Ent. News XVII, 1907, p. 174. **Stenotarsus** Walton, l. c., XXXIX, 1928, p. 217.

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MYLABRIDÆ Boving, Pr. Ent. Soc. Wash. XXIX, 1927, p. 140 (genera of larvæ); Henriksen, Danm. Fauna Bill. VII, 1927, p. 374 (genera of larvæ). **Mylabris** Boving, Pr. Ent. Soc. Wash. XXIX, 1927, p. 141 (larvæ).

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Cossinæ Horn, Pr. Am. Phil. Soc. XIII, 1873, p. 431–447.

Calendrinæ Horn, l. c., p. 407–430. **Calendra** Chittenden, Pr. Ent. Soc. Wash. VI, 1904, p. 128 (*simplex* group); p. 132 (*venatus* group).

SCOLYTIDÆ: Micracinæ Blackman, Tec. Pub. 25, Bull. N. Y. St. Coll. For. I, 3b, 1928, p. 185–208. **Pityophthori** Blackman, l. c., p. 7 (genera). **Myeloborus** Blackman, l. c., p. 17. **Pityophthorus** Blackman, l. c., p. 28–118.

STREPSIPTERA Pierce, Neb. U. Stud. IV, 1904, p. 13 (genera).

II. INDEX TO LOCAL LISTS

GENERAL

Beutenmuller, Jr. N. Y. Ent. Soc. I, 1893, p. 91–96, 134–146, 185–194; II, 1894, p. 42 (n. e. N. A.; 629 sp. Cicindelidæ-Hydrophilidæ; A, C, D); II, 1894, p. 43–48 (supplementary list of 157 sp. Cicindelidæ and Carabidæ, not all additional to first list). **Blunck,** Syll. Insektenbiol. Col. I, 1925, p. 1–36 (150 sp.; C). **Blatchley,** Jr. N. Y. Ent. Soc. XXXVI, 1928, p. 235–262 (98 sp.

Rhyncophora from e. N. A.; A, B, C). **Frost** in Needham, Frost, and Tothill, Leaf-Mining Ins. 1928, p. 294–296 (38 sp. leaf-miners; C). **Stiles and Hassall**, U. S. Hygienic Lab. Bull. 150, 1928, p. 326–342 (87 sp. of importance in public health; A, C). **Chamberlin**, Pan-P. Ent. V, 1929, p. 114–116 (92 sp. Buprestidæ n. of San Francisco).

BERMUDA

Ogilvie, Ins. Bermuda (Dept. Agr. Bermuda) 1928, p. 11–17 (71 sp. plus 12 unidentified sp.; C).*

CANADA

Entomological Record, Ann. Rep. Ent. Soc. Ont. LVIII, 1927, p. 93–99 (305 sp.; A).

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NEWFOUNDLAND

LABRADOR: **Fletcher**, Geol. Surv. Can. VIII, 1896, p. 333L (13 sp.).

UNITED STATES

Blanchard, Ent. Amer. V, 1889, p. 29–32 (N. Eng.; 62 sp. Buprestidæ; A, B, C). **Knull**, Ent. News XXXIX, 1928, p. 314–316 (11 sp., A, C).

ARIZONA: **Wickham**, Ent. News IX, 1898, p. 235–236 (Yuma; 18 sp., C). **Snow**, Kans. Univ. Sci. Bull. II (12), 1904, p. 325–336 (453 sp.; A); Tr. Kans. Acad. Sci. II (I), 1906, p. 161–176 (San Bernardino Ranch and Oak Creek Canyon; 724 sp.; A); XX (II), 1907, p. 141–151 (Pima Co.; 395 sp.). **Schaeffer**, Jr. N. Y. Ent. Soc. XVI, 1908, p. 127 (Huachuca Mts.; 29 sp. Cleridæ).

* Of these 71 species none are endemic, 7 are recently introduced and doubtfully established, 27 are cosmopolitan or at least Holarctic, 17 are exclusively Nearctic, 11 are Nearctic and Neotropical, 5 are exclusively Neotropical, 1 is circumtropical, 1 is Palæarctic (probably introduced), and 2 are unaccounted for. The figures demonstrate the Nearctic character of the fauna, and Bermudan species should be included in future catalogues and check-lists of Nearctic Coleoptera.

CALIFORNIA: **Fall**, Ent. News V, 1894, p. 99–101 (San Bernardino Mts.; 170 sp.). **Wickham**, Ent. News IX, 1898, p. 236–237 (Yuma: 11 sp.; Majave: 24 sp.; Barstow: 24 sp.). **Baker**, 1st Ann. Rep. Laguna Marine Lab. 1912, p. 170–173 (Laguna Beach; 28 sp.; C). **Woodworth**, Guide Cal. Ins. 1913, p. 171–252 (4364 sp.). **Davis**, Bull. Brook. Ent. Soc. XI, 1916, p. 11–12 (10 sp. *Pleocoma*). **Garnett**, Can. Ent. L, 1918, p. 172–177, 205–213, 248–262, 281–284 (221 sp. Cerambycidæ: 178 from Cal., 53 from L. Cal.). **Myers**, Jr. Ent. Zool. X, 1918, p. 43–53 (Claremont-Laguna Beach; 221 sp., A). **Dodds**, l. c., XV, 1923, p. 34–36 (Laguna Beach; 27 sp.). **Illingworth**, Proc. Hawaiian Ent. Soc. VI, 1927, p. 398–400 (Upland; 14 sp. from carrion; B, C).

FLORIDA: **Wickham**, Bull. Buff. Soc. Nat. Sci. IX, 1910, p. 399–405. **Davis and Leng**, Jr. N. Y. Ent. Soc. XX, 1912, p. 120–121 (Cleveland; 41 sp.). **Blatchley**, Can. Ent. L, 1918, p. 52–59 (101 sp.; A, B, C); L, 1918, p. 416–424 and LI, 1919, p. 28–32 (44 sp.; A, B, C).

ILLINOIS: **Brendel**, Bull. Sci. Assoc. Peoria 1887, p. 53–63 (Peoria; 1137 sp., A).

IOWA: **Wickham**, Proc. Iowa Acad. Sci. for 1899, VII, 1900, p. 59–60 (3 sp. *Eleodes;* A). **Sweetman**, Ann. Ent. Soc. Am. XXI, 1928, p. 296 (Ames; 10 sp. from grass roots; C).

KANSAS: **Knaus**, Can. Ent. XXXI, 1899, p. 37–40. **Douglass**, Jr. Kans. Ent. Soc. II, 1929, p. 2–15, 26–38 (315 sp.; A, C).

LOUISIANA: **Leng**, Jr. N. Y. Ent. Soc. X, 1902, p. 132–136 (10 sp. Cicindelidae; A, C). **Rosewell**, Can. Ent. LII, 1920, p. 203 (8 sp. on Black Locust).

MASSACHUSETTS: **Blanchard**, Ent. Amer. V, 1889, p. 29–32 (Lowell; 48 sp. Buprestidæ). **Frost**, Can. Ent. LII, 1920, p. 25–29 (Sherburne). **Taylor**, Psyche XXXV, 1928, p. 220–222 (Boston; 22 sp. from coniferous twigs; C).

NEW HAMPSHIRE: **Mt. Washington**: **Slosson**, Ent. News VI, 1895, p. 318–319 (88 sp.). **Bowditch** 1896, add (672 sp. A, C).

NEW JERSEY: **Leng**, Jr. N. Y. Ent. Soc. X, 1902, p. 236–240 (pine barrens; 13 sp. Cicindelidæ; A, B, C). **Nicolay**, Ent. News XXX, 1919, p. 277 (11 sp.; A, B, C).

NEW MEXICO: Fall, Psyche, 1902, p. 303 (Hudsonian zone; 12 sp.; A, C).

NEW YORK: Chittenden, Ent. Amer. V, 1889, p. 217–220 (Ithaca; 20 sp. Buprestidæ; B, C). Young, Bull. N. Y. St. Mus. 64 (Ent. 17; 18th Rep. St. Ent. for 1902), 1903, p. 153–161 (Newport; 730 sp.).

NORTH CAROLINA: Dury, Ent. News XXII, 1911, p. 273–274 (Plott Balsum Mts.; 24 sp.; A, B, C).

OKLAHOMA: Brown, Okla. Acad. Sci. VII, (1927), 1928, p. 24–28 (53 sp. coprophagous Scarabæidæ; A, B, C).

OREGON: Wickham, Ottawa Nat. XVII, 1903, p. 49–52 (sea beach).

RHODE ISLAND: Davis, Col. R. I. ed. 1, 1901, 40 pp. (795 sp., B); ed. 2, 1902, p. 10–47 (1009 sp., B).

TEXAS: Snow, Tr. Kans. Acad. Sci. XX (I), 1906, p. 140–150. (Brownsville and Galveston; 418 sp.; A). Tucker, Tr. Kans. Acad. Sci. XX (I), 1906, p. 85–89 (85 sp.; A, B). Schaeffer, Jr. N. Y. Ent. Soc. XVI, 1908, p. 127 (Brownsville; 27 sp. Cleridæ).

VIRGINIA: Robinson, Jr. N. Y. Ent. Soc. XXX, 1918, p. 30–33 (Buckingham Co.; 42 sp. on Black Oak).

A GYNANDROMORPHIC SPECIMEN OF TRIGONA CUPIRA VAR. RHUMBLERI (FRIESE)

BY HERBERT F. SCHWARZ

Up to 1913 gynandromorphic individuals had been reported, according to Enderlein,[1] in the case of 78 species of Hymenoptera. Of these, 38 were bees, distributed among the following genera: *Apis, Bombus, Trachusa, Megachile, Chalicodoma, Osmia, Nomada, Anthophora, Tetralonia, Eucera, Xylocopa, Macropis, Andrena, Halictus, Sphecodes,* and *Hylæus.* In a notable recent contribution to the subject of sex anomalies among the *Apoidea,* Professor Mitchell[2] summarizes the additional instances reported in the decade and a half elapsed since the appearance of Enderlein's paper. Only one genus of bees (*Dianthidium*)[3] has been added in that interval to the number represented by gyandromorphs or intersexes, all of the other eleven examples falling within the genera above listed. Although sexual abnormalities had been made known in the case of only five species of *Megachile* (including the subgenus *Chalicodoma*) up to the time when Professor Mitchell issued his paper, his own researches resulted in the discovery of a number of additional instances, assignable to eleven different species.

In view of the relative rarity of these phenomena, it seems worth while to record an instance in a genus and family of bees for which, so far as I have been able to ascertain, no case of gynandromorphism has hitherto been reported. I have recently been going over large series of the stingless bees of the tropics

[1] "Ein hervorragender Zwitter von *Xylocopa mendozana* aus Argentinien." By Dr. Günther Enderlein. Stettiner Entomologische Zeitung, 1913, LXXIV, pp. 124–140.

[2] "Sex anomalies in the genus *Megachile,* with descriptions of new species." By Theodore Bertis Mitchell. Transactions of the American Entomological Society, 1929, LIV, pp. 321–383.

[3] "A gynandromorphic bee of the genus *Dianthidium.*" By C. H. Hicks. American Naturalist, 1926, LX, pp. 199–200.—"North American *Dianthidium, Anthidiellum* and *Paranthidium.*" By Herbert F. Schwarz, American Museum Novitates, Oct. 9, 1926, No. 226, p. 11.

(Meliponidæ) and among them have found an instance of a predominantly lateral gynandromorph. The specimen is one of a large series, numbering about 400, that was taken by Professor J. C. Bradley on June 26, 1920, at El Campamiento, Colony of the Perené, Peru, at an elevation of 2,500 feet. Through the kindness of Professor William T. M. Forbes, who accompanied Professor Bradley on this expedition of Cornell University, I have learned that the bees had established themselves in a large but low earth nest of termites (*Nasutitermes*). I have identified the colony of bees as that of *Trigona cupira* var. *rhumbleri* (Friese).[4]

To enable the reader to visualize to some extent the peculiar effect produced by an individual in which the male and worker characters are divided almost equally so far as the head and thorax are concerned—one lateral half of these parts being mostly worker, the other lateral half exclusively male—it is desirable to point out the sexual dimorphism within the *cupira* group.

Of the tabulated characters the abnormal specimen here discussed has on the left half of its body those described for the male under 1, 2, 3, 4, 5, 6, 7, 8, 9 and on the right side of its body those described for the worker under 1, 2, 3, 4, 5, 6, 7. As to character

[4] Smith's *cupira* is here considered the type species for the group with deeply concave, spoonlike third tibiæ rather than Latreille's *pallida*, which, in accord with Professor Cockerell, I interpret as the equivalent of Friese's *kohli*, an insect of quite different structure.

This adaptable species builds, according to Ducke (1925), who gives a summary of its nest habits: ''Usually in hollow trees or in the nests of termite species erected on trees; Silvestri found in Matto Grosso all three subspecies also in hollows in the earth and in the crevices of walls; in the states of São Paulo, Rio de Janeiro, and in adjacent regions the dark form (subspecies *cupira*) builds frequently an unenclosed nest between epiphytic Bromeliaceæ or on the outside walls of village dwellings (Ihering, 1903, J. Marianno). . . . These unenclosed nests of *pallida cupira* have until now been observed only in the southern parts of Brazil, but are of much rarer occurrence in the State of São Paulo than are those constructed in hollow trees. As tenants in the nests of tree-inhabiting termites the species is (in all its subspecies) of frequent occurrence in Amazonia, but it would seem only here.'' The presence of a colony of these bees in an earth nest of termites in Peru adds another interesting record to their biology.

Male	*Worker*
1. Mandibles short, not overlapping each other, broad at the base, very narrow and diagonally truncate at the apex, with a faint subtoothlike development at the inner edge of the apex.	1. Mandibles long, greatly overlapping each other, broad at the apex, with two sharply defined teeth at the inner edge of the apex.
2. Malar space short, a little more than linear.	2. Malar space about twice as long as that of the male.
3. Space separating eye from clypeus relatively narrow.	3. Space separating eye from clypeus relatively wide.
4. Scape short.	4. Scape long.
5. Flagellum with 12 joints.	5. Flagellum with 11 joints.
6. The middle basitarsi a little narrower than in the worker.	6. The middle basitarsi a little wider than in the male.
7. The hind tibiæ not so broad as in the worker, convex over most of their outer surface, with only a small concavity at the outer end of the apex. The outer surface thinly covered with scattered black hairs.	7. The hind tibiæ conspicuously broad and concave, hollowed out like a spoon. Long fringing hairs laterally, at most two or three longish hairs on the outer surface.
8. The hind basitarsi a little narrower and more nearly parallel-sided than in the worker.	8. The hind basitarsi a little wider than in the male, and a little more abruptly narrowed toward the base.
9. All the tarsal claws cleft.	9. All the tarsal claws simple.

No. 8 there is a little more doubt. The hind basitarsus on the left side of the body is that of the male, but the one on the right side, while broader than its fellow, is not so abruptly narrowed as is usual in the worker. It is at best, however, only slightly aberrant. The most subtle departure from what a superficial examination of the insect would pronounce a scrupulous lateral division into male and female characters reveals itself when the tarsal claws (9) are examined. Those on the left of the body (the male half) are all cleft, as is normally the case in the male. But those on the right of the body (the worker half) are by no means simple throughout, as is normally the case in the worker. Instead, the tarsal claws on the forelegs are cleft, those on the middle legs are simple, while those on the hind leg present the most interesting condition of all—the outer claw being cleft, the inner one simple. Finally it should be said that the partly extruded

genitalia of this specimen reveal themselves as those of the male.

While gynandromorphic individuals are usually a rarity, they have sometimes occurred in numbers, witness the famous hive of honey bees owned by Eugster of Constanz in the sixties of the last century. No less than 87 gynandromorphs from this hive were examined anatomically by v. Siebold[5] (1864) and a residue, numbering 40 abnormal individuals, were studied by Mehling[6] (1915). The bee considered in the present paper was, as already stated, accompanied by about 400 specimens, all taken from the same nest. I had hoped, therefore, upon discovering the gynandromorph to locate additional abnormal specimens among its fellows. But a reexamination of the approximately four hundred specimens, one by one, fails to reveal any abnormality whatever among them. What seemed at first an intersex character was noted in the case of the hind tibiæ of the only two males found among the nest material. Figure G of the accompanying plate may serve to illustrate not only the hind leg on the left side of the gynandromorphic individual but also the hind leg of these two males, although, due to the fact that the drawing had to be made from an awkward angle, the outer edge of the apex of the tibia is sharper than appears to be the case when the leg lies flat. At any rate, the tibiæ, as indicated in figure G, are rather exceptionally broad and their outer surface is rather strongly flattened to concave toward the apical extremity. The hind tibiæ of other male specimens of *cupira* that have come to my attention—Panama, Feb. 28, 1915 (T. Hallinan), and Nov. 7, 1923 (F. E. Lutz), and Pto. America, Rio Putumayo, Brazil, Aug. 30–Sept. 2, 1920 (Cornell University Expedition)—have much narrower hind tibiæ. However, that this broadening of the tibiæ in the specimens from El Campamiento is to be interpreted not as a sexual abnormality but rather as a regional peculiarity is emphasized by the fact that other males from the Colony of the Perené —for instance a series from Pueblo Pardo, June 17, 1920 (Cornell

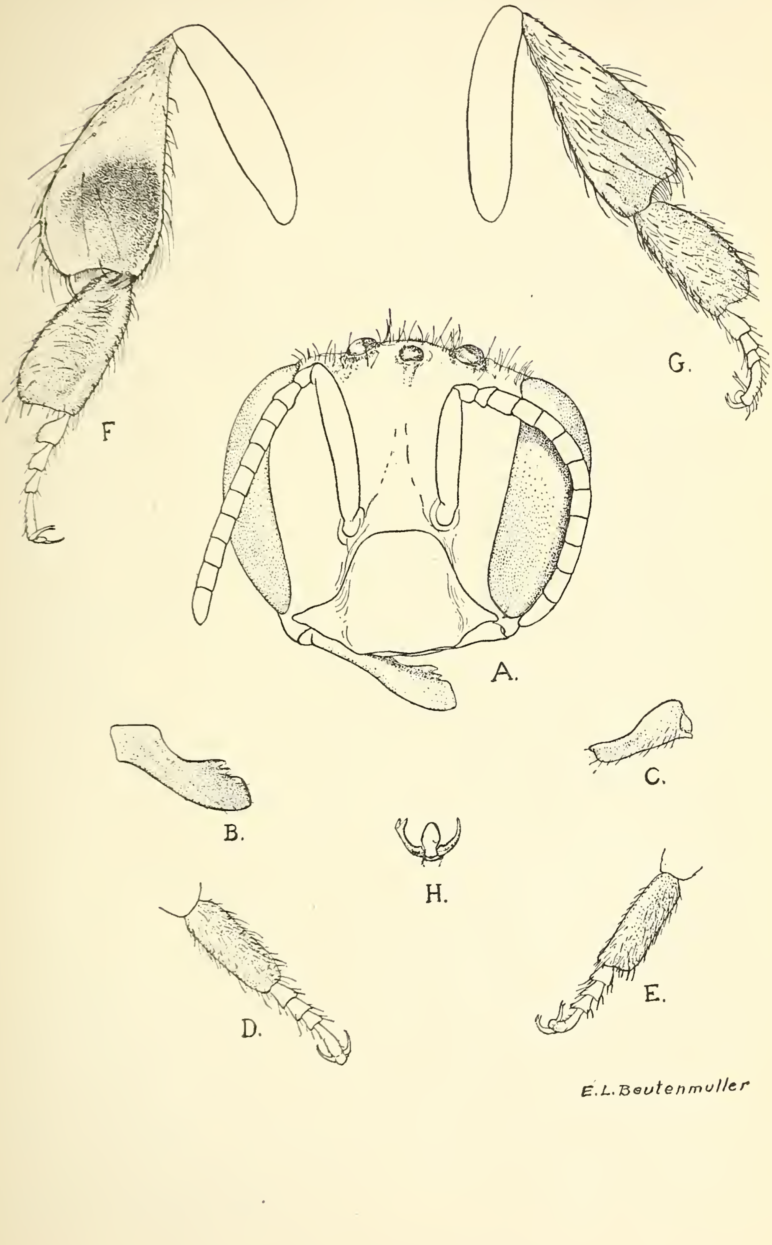
[5] ''Über Zwitterbienen.'' By C. Th. v. Siebold. Zeitschrift für wissensch. Zool., 1864, XIV, pp. 73–80.

[6] ''Über die gynandromorphen Bienen des Eugsterschen Stockes.'' By Elsa Mehling. Verhandlungen der Physik.-Med. Gesellschaft zu Würzburg, 1915, XLIII, pp. 171–236.

University Expedition)—have tibiæ as broad as those of the males from El Campamiento. That the Pueblo Pardo males represent a distinct nest is indicated not only by the different collecting locality (although both Pueblo Pardo and El Campamiento are at low level at the north end of the Chanchamayo Valley, I am informed by Professor William T. M. Forbes) but by the fact that these males have the dark coloration of typical *cupira* in contrast to the El Campamiento specimens, which align themselves in coloration with *rhumbleri*. Yet the structural peculiarity noted is evidenced in both. Friese's description of *rhumbleri* was based on the worker and embraced specimens of this cast from Peru as well as from Colombia and Brazil. In the interests of conservatism the gynandromorphic individual of this paper has been referred to *rhumbleri*, but it is open to doubt whether, in view of the characters noted in the male, it should not constitute a new variety.

A Gynandromorphic Individual of *Trigona cupira* var. *rhumbleri* (Friese)

Fig. A represents the head of the gynandromorphic individual, with the worker characters on the left side of the median line and the male characters on the right side. Note especially the disproportion in the length of the scapes; the presence of 12 segments in the worker antenna, of 13 in the male; the greater breadth of the male eye and its closer approach to the clypeus notwithstanding the fact that the lateral angles of the clypeus are on the male side of the face less attenuated and shorter than on the worker side; the longer malar space on the worker side and the less sloping character of the top of the head. The male mandible is concealed in Fig. A but is shown in Fig. C, contrasted with the worker mandible, also partly concealed in Fig. A but fully revealed in Fig. B. In Fig. D the slightly broader character of the basitarsus of the middle leg of the worker half of the gynandromorph compared with that of the male half (Fig. E) is indicated. Figs. F and G reveal the different character of the hind legs of this abnormal specimen, Fig. F representing the tibia and tarsal joints of the worker half and Fig. G the corresponding portions on the male half. A curious abnormality in the claws of the leg that is depicted in Fig. F is indicated in greater enlargement in Fig. H. Although in the main the leg represented in Fig. F has the character of the worker, its tarsal claws, as Fig. H indicates, are cleft on one side after the manner of the male, uncleft on the other side after the manner of the worker.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E.L.Beutenmuller

THE DEVELOPMENT OF RUSSIAN ENTOMOLOGY*

By I. A. PARFENTJEV

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During the last few years there has been a rapid development of Russian entomology both along theoretical and applied lines. Theoretical entomology is concerned mainly with a systematic study of the Russian fauna. The universities are largely concerned with this type of work although recently this field has been expanded by the establishment of local museums of natural history in the different districts of the country. The entomological divisions of these museums are engaged chiefly in systematic, faunistic, and ecological research. The increasing number of organizations of young naturalists has also advanced our knowledge of the Russian insect fauna. In addition to the above mentioned agencies, the Zoological Museum of the Russian Academy of Science is conducting systematic and faunistic studies of insects. Besides the instruction given by the different colleges and universities in entomology there is the newly established Institute of Entomophytopathological Education (*Iziph*) in Leningrad.

The work in applied entomology is directed by special bureaus of plant protection located in the several republics in which Russia is now divided. They are called *O.Z.R.A.*—the first letters of the Russian words "Bureau of Plant Protection." These bureaus are the centers of administration for applied entomology, phytopathology and the control of injurious rodents. In the different districts we have *stazra*—stations for plant protection. They are of the same general character as the entomological field stations in the United States, but have charge of the control of injurious insects, fungi, and rodents. The work falls in three main classes: 1. Control, 2. Research, 3. Extension.

Many of the Russian agricultural experiment stations have separate entomological divisions which conduct work only in applied entomology. At the present time the entomologists of the

* Presented by Albert Hartzell at the Feb. 5, 1929, meeting of the New York Entomological Society.

experiment stations are doing considerable work in determining the importance of injurious insects to different crops, and in the solution of these large scale problems statistical methods are used. The entomological work of the experiment stations is directed by the Government Institute of Experimental Agriculture. This Institute is reorganized from a scientific committee which before the war and revolution published many papers on applied entomology. The rapid development in Russia along applied lines has given rise to several new organizations for insect control. Some years ago a special entomological division was established by the Sugar Trust; last summer another was founded for forest entomology and a few days ago I received information to the effect that a very large division has been established for the control of cotton insects.

The work in medical and veterinary entomology is not so well developed. There are only four tropical research institutions which are studying insect borne diseases of man. There are very few stations concerned with the relation of mosquitoes to malaria. At the present time we have no special organization for veterinary entomology and there are relatively few investigations on this subject. These questions are of great importance and I hope that they will be developed in the future. Recent observations have convinced me that the effect of insects on domestic animals has a great influence on the lives of many people in Russia. In northern Turkestan there is a semi-arid country called Kazastan. Extensive areas in this country are below sea-level and the rivers form large inundated regions. Grass (*Fragmites communis*) grows in abundance in these marshes forming breeding places for locusts (*Locusta migratora*) which occur here in very great numbers. This interferes with the production of cereals on the adjacent uplands as the first sowing is very apt to be eaten by locusts which migrate from these inundated areas. The people, therefore, have developed this as a grazing county rather than a farming region. During the summer the surrounding county is not habitable because of the large number of mosquitoes and flies that swarm from these extensive marsh areas. The inhabitants are forced to abandon their homes and hunt suitable pastures for their cattle in the mountains. The depredations of

insects, therefore, forces these people to abandon fixed agricultural pursuits and become nomads.

I wish to briefly relate the work of the Central Laboratory for Research on Fungicides and Insecticides which was established in Moscow in 1922. One of the difficulties in the control of locusts in southern and eastern Russia is that the area in which they breed is swampy. This makes airplane dusting the only plausible means of control, but before the effectiveness of the method could be established it was necessary to conduct large scale airplane dusting experiments. Favorable results were obtained by airplane dusting, using sodium arsenite and calcium arsenite. It required very small amounts of arsenic to kill the insects—about 2 kilos[1] per hectare.[2] Chemical analyses and biological tests showed that the width of the arsenical dust-cloud was about 100 meters[3] and that dusting could be done at the rate of a hectare in three seconds. During three years about 50,000 hectares[4] were dusted by airplane, without a single accident.

At the same time that this work was in progress the action of different arsenical compounds upon the locust was being investigated. Among the different compounds of arsenic we selected calcium arsenite as being very toxic and cheap. The question of arsenical injury to plants was not involved but this work suggested the possibility of using these compounds for dusting and spraying cultivated plants.

The economic importance of this problem induced me to undertake some work in the United States and at the present time I have an opportunity to study some of its chemical phases at the Boyce Thompson Institute for Plant Research, Inc.

Since Russia stands second only to the United States in applied entomology an exchange of publications would be helpful to the workers of both countries. Owing to linguistic differences and the lack of communication that has arisen since the war this contact has not been maintained. It would afford me great pleasure to assist American entomologists in obtaining Russian publications in exchange for American.

[1] A kilo is equivalent to 2.2046 avoirdupois pounds.

[2] A hectare is equivalent to 2.471 acres.

[3] A meter is equivalent to 3.280 feet.

[4] Equivalent to approximately 125,000 acres.

A NEW SPECIES OF BEMBIDION FROM LAKE SUPERIOR (COLEOPTERA, CARABIDÆ)

BY HOWARD NOTMAN

The species here described presents such marked peculiarities that a new subgenus seems required for its reception. The form of the eighth elytral stria indicates its close relationship to the species of the subgenera *Chrysobracteon* Net. and *Odontium* Lec. The elytra are strongly alutaceous and dull throughout with the striæ fine, unimpressed and finely and feebly punctured as in the species of *Chrysobracteon*. In general appearance it is not unlike *Bembidion velox* L. of Europe. The disc of the elytra is, however, quite even and not impressed or foveate. The type has no discal setigerous punctures. It is not safe, perhaps, to conclude that this is characteristic since the dorsal punctures are occasionally accidentally missing in individual specimens. The even surface of the elytra and the lack of foveæ would ally the species rather to *Odontium*. Another remarkable character is the presence of a strong tuberculation near the apex of either elytron, a character seemingly rare if not altogether unknown in *Bembidion* and possibly indicating an affinity with *Elaphrus*. The sub-generic name *Parabracteon* is suggested for the new species.

Bembidion (*Parabracteon* new sub-genus) *tuberculatum* new species.

Form elongate-oval, rather gradually and evenly acuminate posteriorly from the middle of the elytra. Color dull blackish bronze; legs and first antennal joint rufous, the knees and tarsi darker. Integuments strongly alutaceous and dull, crest of the ocular ridges and the disc of thorax more shining. Eyes large and strongly convex; antennæ rather more than one-third the length of the body, medial joints more than twice as long as wide; head wider than thorax at apex, and nearly three-fourths the total width. Thorax very transverse, two-thirds wider than long, widest a little before the middle, base a little wider than apex, sides strongly rounded anteriorly and broadly and distinctly sinuate posteriorly; base obliquely truncate either side with posterior angles rectangular; anterior angles slightly produced and reflexed; posterior angles with a short but very distinct carina; there is a seta in the posterior angle and a lateral seta near the middle. Elytra three-fifths longer than wide, one-half wider than thorax and considerably more

than three times as long; eighth stria similar to the seventh, unimpressed and distant from the margin. There is a strong tuberculation between the seventh and eighth striæ near the apical, marginal sinuation. The basal margin is short and forms an angle with the lateral margin. Length 5.6 mm., width 2.5 mm.

Type, female, Marquette, Mich., 13 May, 1923, in the collection of the author.

Taken by the author on a broad sandy beach in company with *Bembidion carinula* Chaud., which species was very abundant.

A NOTE ON VETERINARY ENTOMOLOGY OF THE SIXTEENTH CENTURY

By Harry B. Weiss
New Brunswick, N. J.

George Turbevile's "Booke of Hunting," published in 1576, which outlines the "nature and hunting of the Bucke, Raynedeare, Rowe, wilde Goate, wilde Bore, Hare, Conies, Foxe, Badgerd, wildcat, Otter, Wolfe and Beare" also contains a chapter on "Receipts to heale sundrie diseases and infirmities in houndes and dogges." Among the "diseases and infirmities" mentioned are mange, fleas, lice and ticks and it is of interest, in the light of present-day knowledge, to know the sixteenth century attitude toward these parasites.

Four kinds of mange were recognized, "viz, the red Mange which maketh a dogges legges to swell. The skaly Mange, which groweth in patches, as broad as the palme of a mans hande, and taketh off the skinne where it goeth. The Common Mange, and the blacke Mange, which lyeth under the skinne, and maketh the hair to shed. Of these manges the red Mange is the worst, and most dangerous to heale. For it engendreth and breedeth after a foundering or overheating of a dog, which he taketh in the winter, passing over brooks or pooles, when he is hote and chafed. Or with lying in colde and moyst places, before he be well dryed or rubbed. Or it may come by being brought up in the shambles, or butcheries, with the bloud of Oxen or suche like, which overheateth the bloud in a dog. And those kindes of Mange are thus to be healed. First purge your dogge with the receipt which I have before prescribed to be ministered before bathing, and on the morrow let him bloud two ounces or more, upon a vaine which is betwene the hough string, and the bone of his leg. And within two dayes next following, you shall annoynt him with this oyntment which followeth.

"Take three pound weight of the oyle of Nuttes (I thinke he meaneth Walnuts) a pounde and halfe of the oyle of Cade, two

pound of the oyle of Wormes, three pound of Honny, and a pound and a half of Vyneger, boyle them al together, untill they be halfe wasted. Then put to it Rosen and Pytch, or Tar, of each two pounds and a half, and half a pound of new waxe unwrought, melt them altogether, and stir them with a reede or a palme wand. When they are well melted and mingled, put therein (from off the fire) a pound and a half of Brymstone, two pound of Copporas well tried, XII ounces of Verdegreace, and styr them into it until it be cold. This oyntment will kill and heale all manner of manges and itches, how strong or vehement soever they be. And before you anoynt your dogs therewith, wash them and rub them all over with water and salt to clense their skins. Afterwardes leade them to a good fire, and tye them there fast, until they may sweate a good houre and a half, giving them water to drinke and lap their belly full. When they are thus dressed and warmed, feede them with good broths made with Mutton, boyled with a little brimstone to warme them within, and with good holsome hearbes, continuing that dyet eight dayes.''

Apparently Turbervile's ''skaly'' mange was due to the presence of psoroptic mites and his ''common'' and ''blacke'' mange were due to itch mites, perhaps *Sarcoptes scabiei* var. *Canis.*

For the ''common Mange'' which was supposed to be due to impure drinking water, dirty straw or kennels, the treatment was as follows,—''Take two handfull of wild Cressyes, otherwise called *Berne,* two handfull of *Enula campana,* of the leaves or rootes of wylde Sorrell, and the roote of *Roerb* as much, and the weight of two pounds of rootes of *Frodyls,* make them al boyle wel in lye and vineger. When they are all well boyled, you must streine the decoction, and take the juice thereof, mingling it with two pounds of grey Sope, and when the Sope is well melted and mingled in it, then rub your dogs with it foure or five days together, and it wil heale them. This receipt and al ye rest I have proved and found medicinable.''

For ''Fleas, Lice, Tykes, and other vermin on dogs, and to keepe them cleane,'' the remedy was,—''Take two handfull of the leaves of Berne or wild Cressyes, as much of wild Sorrell, as much of Mynts, and boyle them in lye made with vine leaves, and put amongst them, two ounces of Stavesaker. When it is well

boyled, streyne them cleane, and take the decoction, and mingle therein two ounces of Sope, and one ounce of Saffron, with a handfull of Salte. Mingle all this together, and washe your dogs therewith.''

From the make-up of these remedies, they were undoubtedly more or less successful, especially the one containing sulphur. At the present time, sulphur in one form or another is used quite effectively against certain mites.

BOOK NOTICES

Insects and Their Control. By Andrew Wilson, Springfield, New Jersey, 1929. 342 pages, 184 illustrations.

"For as in the same pasture, the Oxe findeth fodder, the Hound a Hare; the Stork a Lizard, the faire maide flowers; so we can not, except wee list our selves but depart the better from any booke whatsoever."—Peacham.

In several particulars, this book departs from prevailing entomological proprieties. It has no table of contents. It contains the scientific names of only six insects and it is my guess that these crept in by mistake. And instead of the insecticides usually recommended in books on injurious insects, one finds that Wilson's Grub-O, Wilson's Moth-O, Wilson's Scale-O and Wilson's etc., etc., etc., will do the trick.

According to the introduction, the book was prepared to help the home owner learn more about injurious insects and to advertise the products of Andrew Wilson, Inc. The common insects attacking orchard, field and ornamental plants are treated, and the alphabetical arrangement of the plants makes a table of contents unnecessary for anybody except a reviewer. The omission of scientific names is not so terrible after all, because home owners, as a rule, care nothing about such names and their interest is confined usually to the accumulation of a few facts about the insect and a knowledge of combating it. And as the book was written in part for advertising purposes, it is too much to expect Mr. Wilson to modestly avoid mentioning his own products.

The accounts are brief, to the point, and entomologically sound. Mention is even made of the Japanese Aserica, a species which has not yet found its way into our text-books and manuals. Small portions of the book are devoted to insects in general and means of controlling them and to spray schedules for fruits. The illustrations are uniformly good. The book contains no misspelled scientific names, but on page 325 a minor error occurs. Eight of the nine figures on this page are credited to Riley, when as a matter of fact only figure 9 is "after Riley." Figures 2 to 6 are "after Mutchler and Weiss."—Harry B. Weiss.

A Handbook of the Dragonflies of North America. By James G. Needham and Hortense Butler Heywood. Charles C. Thomas, Springfield, Illinois. VIII + 378 pages, 149 illustrations, bibliography and index. $7.00, net.

I do not know how many dragonfly collectors there are in North America at the present time, but their number should be increased once the information is disseminated among naturalists that such a book as this is available. It is more than a readable account of the three hundred and sixty species of dragonflies and damselflies in North America, and their habits and economy. It is a book for collectors, for collectors who are more than mere gatherers of specimens. It is a book for collectors who enjoy the sport of collecting, the swift flight of the insects, the sunlight on their wings, motionless pools, and wet meadows. And the authors must be collectors of this sort also, otherwise they never would have incorporated in their book such sentences as:

"Ten or a dozen specimens were patrolling back and forth just after sunset in one corner of an old pasture near a small brook at the foot of the mountains. They were strong and rapid fliers and extremely difficult to capture. They moved gracefully up and down and in and out, weaving together their paths of flight like the intricate mazes of an old fashioned dance."

And—

"They were covered with glistening rain drops which were shaken from their wings as they fluttered from perch to perch."

And again—

"The hairy nymph squats amid the black ooze in stagnant ponds and climbs only a little way out of the water to transform."

Collecting dragonflies requires more than the mere swinging of a sweep-net. These insects have to be stalked. The collector must have patience, and dexterity, and must study their habits and use some skill in outguessing them, otherwise his efforts will go unrewarded. After reading this Handbook, I wanted to get out my net and make tracks for the nearest open marsh. I had a hankering to see these sleek, brilliantly glittering insects tirelessly and swiftly skimming and wheeling over still water. I wanted to test my patience and knowledge against their powers

of flight and their habits. And then if I were successful, I wanted to bring my captures home and identify them by means of the "keys" which the Handbook provides—"keys," not in eight-point type either, but in ten-point and with the lines so spaced that they invite the collector to use them.

But this is not the kind of review that entomologists, as a rule, expect. I haven't hunted for any typographical errors, and if there are any misspelled scientific names I am blissfully unconscious of them. And in addition I haven't said anything about the contents of the book, its orderly arrangement into a "general" part and a "systematic" part, the former concerned with the adults and immature stages, their habits, histories, structures, etc., and the latter with brief diagnostic descriptions of the species and with all that is known about their habits. And this is all I am going to say about the contents because it bores me frightfully to repeat what the publisher already has printed. It is essentially a book for collectors, a book that will make new collectors, and a book that should stimulate collectors to add more facts to our present knowledge of dragonfly habits, ecology and distribution.—Harry B. Weiss.

NEW MEMBRACIDÆ, VIII

By FREDERIC W. GODING

Subfamily **Membracinæ**

Tritropidia utahensis, new species.

Yellow, summit front horn, tips tegmina, and chest ferruginous, two piceous spots on dorsum. Head much longer than broad between eyes, nearly quadrangular, densely pale pubescent, base lightly arched; eyes prominent, piceous; ocelli pale yellow, nearer to and on a line with center of eyes; margins nearly straight, almost equal in width to base, truncate, acutely angulate. Pronotum yellow, with dense short pale yellow pubescence, elevated in front in a short upright horn which is very slightly inclined forward, margins nearly parallel, a strong carina each side from the ferruginous summit lateral margin behind humerals each emitting a weak branch which extends for some distance on metopodium; median carina percurrent, foliaceous behind front horn, slightly elevated behind middle with a black spot, the sinus behind it white; apex piceous, extended to interior angle of tegmina. Tegmina pale ferruginous, apical half darker and mottled with white, nearly three times long as broad, apices acutely angular; exterior basal half opaque, punctate, all veins with short yellow hairs. Chest and tips tarsi fuscous, front and middle tibiæ much broadened, hind tibiæ with short black spines, legs otherwise yellow; abdomen yellow apex ferruginous. Type, female, long. cum teg. 5 mm.; cum corn. 7 mm.; lat. 2 mm. Taken at Santa Clara, Utah, by Mr. E. W. Davis, who retains the type.

Near *bifenestrata* Funkhouser, but differs in the larger size, color and markings, dimensions of head, location of ocelli, shape of front horn, without translucent areas, and very short anterior branching carina. An unnamed specimen is in the National Museum at Washington.

Leioscyta trinotata, new species.

Black, densely pale pubescent, three white spots on dorsum. Head with basal half fuscous, apical half fuscous yellow, slightly longer than wide between eyes; base lightly arched; ocelli slightly nearer to and even with center of eyes, distant from base, large, pale yellow; lateral margins next to eyes testaceous, sinuate below eyes, apical margin truncate and nearly as broad as base; pubescent. Pronotum black, metopidium perpendicular, summit forming a sharp angle with dorsum, with no short carinæ; one strong carina each side united at summit extended to middle lateral margin posterior process; humerals not very prominent, testaceous; posterior process

shorter than abdomen, reaching middle of 5th apical cell of corium; three white spots—one at summit, one on middle of dorsum, and one subapical. Tegmina black, basal third immaculate, middle third with numerous white dots, apical third fuscous yellow, apical cells mostly clear hyaline; basal two-thirds opaque. Body black, legs with a few small yellow dots, tarsi sordid testaceous. Type, female, long. 4 mm.; lat. 1.5 mm., in the collection of Mr. E. W. Davis. Taken by Mr. H. E. Wallace at Millican, Utah, August 1, 1927.

Subfamily **Smiliinæ**

Micrutalis flava, new species.

Small, shining yellow, sometimes more or less clouded with very pale ferruginous, lateral margins posterior process including apex always white; posterior process long as abdomen, reaching apical marginal vein of corium. Tegmina colorless hyaline, veins white, slightly longer than abdomen. Body and legs pale yellow. Type, female, long. 2.5 mm.; lat. 1 mm., in collection of Mr. E. W. Davis; twenty-six other examples were also examined, all collected by Mr. E. W. Davis at Littlefields, Utah, in June, 1928.

Note: In the Journal (XXXVII) for March last, the name of the type species of the genus **Metcalfiella** was inadvertently omitted from "Notes on Some South American Membracidæ" page 7; the type of the genus is *Hoplophora pertusa* Germar.

After "New Membracidæ VI" was in print (page 12) an example of "*Acutalis tripunctata* Fairmaire" was examined, which proved it to belong to the genus *Micrutalis* Fowler. On the same page, the name **Anchistrotus buctoni** should read **bucktoni** new species.

SOME PARASITES OF THE ORIENTAL PEACH MOTH IN NEW JERSEY

BY BYRLEY F. DRIGGERS
NEW JERSEY AGRICULTURAL EXPERIMENT STATION, NEW BRUNSWICK, N. J.

In 1928 Stearns[1] published a list of parasites of the Oriental Peach Moth giving their distribution in the United States on that host. Of the thirty-nine primary larval parasites reported, twenty-eight were recorded from New Jersey. At the same time two primary pupal parasites and three secondary parasites of the Oriental Peach Moth were recorded from New Jersey.

During the summers of 1927 and 1928 the writer collected a large number of larvæ of the Oriental Peach Moth from twigs and fruit in the field. Collections of hibernacula of the peach moth were made also in the early spring of 1928. From these collections certain species of parasites were reared which are not recorded in the list published by Stearns.

In July and August of 1928 the writer exposed, in the large variety orchard at the college farm, pupæ that had been reared in the insectary from apples on which peach moth eggs in the black spot stage had been placed. After having been in the orchard one or more days the pupæ were vialed and records kept of any parasites that emerged. Two species not recorded in Stearns' list were obtained. These species, together with the species obtained from the collections mentioned, are given in table 1. The species were determined at the National Museum, Washington, D. C.

TABLE 1.—PARASITES OBTAINED FROM PEACH MOTH PUPÆ, SUMMER LARVÆ AND HIBERNACULA COLLECTED FROM DIFFERENT LOCALITIES IN NEW JERSEY IN 1927 AND 1928.

LARVAL PARASITES	PUPAL PARASITES
Macrocentrus delicatus Cress.	*Syntomosphyrum esurus* Riley.
Macrocentrus sp.?	*Miotropis clisiocampæ* Ashm.
Eubadizon pleuralis Cress.	
Calliephialtes n. sp.	SECONDARY PARASITES
Lixophaga plumbea Ald.	*Eurytoma* sp. near *tylodermatis*
Lixophaga mediocris Ald.	*Eupelmus amicus* Gir.
Dioctes obliteratus (Cress.)	

[1] Stearns, L. A. 1928. The Larval Parasites of the Oriental Peach Moth (*Laspeyresia molesta* Busck) with Special Reference to the Biology of *Macrocentrus ancylivora* Rohwer. N. J. Agr. Expt. Station Bull. 460.

Macrocentrus delicatus Cress. This species has been reared from larvæ collected at New Brunswick, Glen Moore, South River, Manasquan and Middletown. At New Brunswick, in 1928, the parasite was reared from larvæ collected in June, July, August and September. It was the most numerous parasite at that locality for that year.

Macrocentrus sp. This parasite which appears to be neither *M. delicatus* nor *M. ancylivora* is represented by one female specimen. It was reared from a larva collected at Moorestown on July 13, 1928.

Eubadizon pleuralis Cress. One specimen of this species was reared from a peach moth larva collected from peach twig at South River on July 17, 1928.

Calliephialtes n. sp. This species was reared from material collected in the early spring at New Brunswick, South River, Glen Moore and Riverton.

Lixophaga plumbea Ald. Three specimens of this dipterous parasite were reared from peach moth larvæ collected from twigs at New Brunswick; two were collected in June and one in August, 1928.

Lixophaga mediocris Ald. One specimen of this parasite was reared from a larva collected from twigs at New Brunswick on June 12, 1928.

Dioctes obliteratus (Cress.). One specimen bred from peach moth larva collected at Lebanon, August 1, 1928.

Syntomosphyrum esurus Riley and *Miotropis clisiocampæ* Ashm. These two pupal parasites were bred from pupæ exposed in the field in July and August, 1928.

Eurytoma sp. near *tylodermatis* Ashm. This species was reared from material collected in the early spring at New Brunswick, South River and Glen Moore. This species apparently is parasitic on *Glypta* as in every case the specimens collected were in the larvæ or pupal stage and were within a typical *Glypta* cocoon. In several instances cocoons were dissected which contained, besides the *Eurytoma* larva or pupa, the remains of what had been a nearly mature *Glypta*.

Eupelmus amicus Gir. This parasite was obtained from material collected in the early spring at New Brunswick, South River and Glen Moore. Like *Eurytoma,* this species was found in cocoons similar to those characteristic of *Glypta*.

NEW MEMBRACIDÆ, IX

BY FREDERIC W. GODING

Subfamily **Centrotinæ**

Centriculus flavus new species.

Similar to *C. rufotestaceus* Fowler, in the convex unarmed pronotum, position of ocelli, and color of the chest, abdomen and legs; it differs in the smaller size, much shorter posterior pronotal process which is little more than a slightly crested point over base of scutellum, the narrower scutellum with briefly bidentate apex, the bright yellow color of the pronotum; the tegmina are clear hyaline, veins and large spot behind apex of clavus, brown. Type, ♀, long. cum teg. 5, lat. 1.5 mm.; from Suiza Turalba, Costa Rica, (*Schild*), through E. W. Davis.

Subfamily **Membracinæ**

Notocera spinidorsa new species.

Black; suprahumerals slender, summits dilated, two dorsal nodes, spinules almost limited to median carina. Head black, twice longer than broad, flat, minutely punctate, base slightly arched; ocelli white, nearer to and even with center of eyes; eyes large, gray; apical margin obtusely rounded to acute apex of clypeus. Pronotum black, coarsely punctured, median carina percurrent with spinules; suprehumerals seen from front very slender, compressed, diverging, summits abruptly and slenderly broadened and bidentate, slightly recurved, seen from side triquetrous, moderately broad, few spinules on hind margin, summits obliquely truncate, tips acute; posterior process with a slightly elevated strongly spinose node just behind humerals, a second larger conical node at middle with minute spinules over middle, apical part lightly convex, acuminate, decurved, median carina and margins with small spinules, long as tegmina. Tegmina black, opaque, punctured on basal half, extreme tips narrowly yellow. Body and legs black, tarsi testaceous. Type, ♂, and two ♀ paratypes, similar, long. cum teg. 5; lat. 1.5; lat. int. corn. 4 mm., from Suiza Turalba, Costa Rica, (*Schild*), through E. W. Davis.

Similar to *N. cerviceps* Fowler; it differs in having two dorsal nodes on the posterior pronotal process, and totally black tegmina except the narrow yellow tips.

Subfamily **Hoplophorioninæ**

Alchisme costaricensis new species.

Head brown, minutely hairy, twice wider than long, uneven not punctate, base straight at middle convex each side; ocelli luteus, equidistant, even

with center of eyes, each in a quadrangular yellow spot; lateral margins straight meeting at apex of large triangular strongly inflexed clypeus. Pronotum brown and yellow irrorate, metopidium convex, elevated just behind humerals in a straight horn slightly inclined forward, sides parallel and carinate, anteriorly brown posteriorly yellow; humerals long, broad, flat and black above, concave and yellow beneath, extended outward and some forward, tips obtuse; median carina percurrent; posterior process rather depressed, gradually acuminate reaching apex of 4th apical cell of corium, lateral margins from humerals narrowly and apical part yellow, very slightly pilose; sides and metopidium with smooth elevated lines. Tegmina translucent yellow, four times longer than broad, narrow, 3 longitudinal veins, basal half costal and first basal cells and base of clavus opaque, punctate; 2 long narrow discoidal cells, the exterior cell petiolate, 5 apical cells all long and narrow except very short second cell. Wings with 4 apical cells, second cell with base truncate, sessile. Chest piceous, abdomen sordid yellow, legs yellow, tarsi ferruginous. Type, ♂, long. cum teg. 7; lat. 4 mm., from Suiza Turalba, Costa Rica, (*Schild*), through E. W. Davis.

Allied to *A. truncaticornis* Germar; it differs in the dorsal horn with its sides parallel, not triangular, posterior pronotal process nearly long as tegmina, much smaller size, and fuscous chest. Other than the cornute humerals it resembles the figure of *Potnia rectispina* Funkhouser, in Can. Ent. xlvi, pl. 24, fig. 9.

Subfamily **Smiliinæ**

Poppea albiloba new species.

Black testaceous and white. Head reddish brown, triangular, uneven, not punctate, a shallow sulcus from base; base nearly straight; ocelli equidistant; lateral margins sinuous and produced below each eye in a small flat plate; clypeus long, apex slightly produced and rounded. Pronotum shining, with several colors, metopidium to base of dorsal spines extended each side to humerals testaceous with two short oblique white stripes from base; discal spines black, base strong gradually acuminate, curved upward, outward and backward; posterior process seen from side with a large hemispherical bulb just behind discal spines, a reticulated pearly white broad transverse band reaching lateral margins each side and including the bulb; behind the bulb and deeply excavated between the trifurcate process appears as a second bulb equal in size to the first bulb, black mottled with testaceous, emitting 3 spines all on a level, median spine longest white except base narrowly, subapical band and tip piceous, equaling base 3d apical cell of corium; lateral apical spines strong at bases moderately narrowed and acuminate from middle, projecting directly backward behind the basal curve, slender part white except tip. Tegmina with the usual venation, basal veins and veins to discoidal cells piceous, otherwise vitreous.

Body and legs testaceous, abdomen black, apex yellow. Type, ♂, long. cum teg. 7; lat. 2 mm., from Suiza Turalba, Costa Rica, (*Schild*), through E. W. Davis.

It has a superficial resemblance to *P. subrugosa* Fowler, but may be easily identified by the very broad pearly white transverse band across the dorsal node.

Antonæ nigropunctata new species.

Orange yellow with small black dot on apex clypeus, two spots on middle of dorsum, one at base and at tip apical spine, one each side on middle lateral margin, and discal spines, black; small spot on base and transverse vitta at middle each tegmen, apical veins, dot near apex clavus, abdomen above and beneath, and eyes, piceous; head pale brown, chest and legs yellow. Pronotum convex, discal spines nearly horizontal; posterior process swollen at base, without semicircular impression each side, apical part long, slender, subulate. Type, ♂, long. cum teg. 5.5; lat. int. hum. 1.5 mm., from Suiza Turalba, Costa Rica, (*Schild*), through E. W. Davis.

This beautiful species is similar in form to *A. inflata* Stal; it differs in the much smaller size, color and markings of the pronotum, not pilose, and the totally clear hyaline tegmina.

Membracidoidea new genus.

Head nearly long as broad, wide as base posterior pronotal process, uneven, median carina from base to middle, fovea at base and one at apex clypeus; base well arched; ocelli equidistant, even with center of eyes; lateral margins rounded to apex clypeus. Pronotum highly elevated anteriorly, almost foliaceous, subcompressed, superficially resembling some species of the genus *Membracis*; metopidium vertical, summit slightly advancing and briefly rounded, dorsum unevenly curved to posterior apex which reaches tips of tegmina; sides with several rugæ and covers half the tegmina; humerals prominent, conical. Tegmina two and one-half times longer than broad, 3 parallel longitudinal veins on the exterior half of tegmina, space between subcoriaceous, opaque, densely punctate to bases apical cells; no discoidal cell, 5 apical cells, base third cell petiolate, the fifth cell with anterior basal cell and clavus occupying more than half the width of tegmina; costal and interior margins nearly straight, posterior margin obliquely truncate, apical angle acutely pointed, limbus rather broad toward interior angle. Wings with 4 apical cells, base second cell petiolate. Legs simple. Type *Membracidoidea rubridorsa* new species.

This genus should be placed in the "Classification" before *Hille*, but differs from the other members of the group by the

strongly elevated pronotum without horn or crest. It has a superficial resemblance to species of the genus *Membracis,* but the slender, triquetrous tibiæ, elevated lines, and venation easily separates it.

Membracidoidea rubridorsa new species.

Head, metopidium and superior half of pronotum to apex red, inferior half creamy white, the two colors separated by a heavy black line each side united at base, curved above humerals to posterior fourth of lateral margin; lateral elevated lines few and weak. Tegmina with the free part yellow mottled with black, covered part and large spot behind coriaceous area colorless hyaline, a large piceous spot on apical angle. Body sordid yellowish brown, black spot on middle of chest, abdomen piceous apex dark testaceous; legs brownish with short pale hairs. Type, ♀, long. cum teg. 7; lat. 3.5 mm., from Suiza Turalba, Costa Rica, (*Schild*), through E. W. Davis.

This species will not be confused with any other of the family, and may at once be known by the elevated pronotum, the distinctive red and white sides with the black line between. *Adippe concinna* has a similar black line each side, but otherwise the sides are concolorous, while the metopidium is convex in the one, and vertical with its summit slightly advanced in the other.

All types of the above described species have been returned to Mr. E. W. Davis, who states that they will be placed in the National Museum at Washington, as they are government property.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

MEETING OF JANUARY 15, 1929

A regular meeting of the New York Entomological Society was held at 8 P. M., on January 15, 1929, in the American Museum of Natural History; President Henry Bird in the chair with sixteen members and two visitors present.

The treasurer, William T. Davis, reported a balance January 1, 1929, of $1579.35.

A rising vote of thanks was tendered to Mr. Davis for his twenty-five years of efficient service as treasurer of the Society.

The Nominating Committee submitted the following nominations for officers of the Society in 1929, viz.:

For President	Wm. T. Davis
For Vice-President	Andrew J. Mutchler
For Secretary	Chas. W. Leng
For Treasurer	G. C. Hall
For Librarian	Frank E. Watson
For Curator	A. J. Mutchler

Executive Committee	*Publication Committee*
Henry Bird	Harry B. Weiss
H. G. Barber	F. E. Lutz
Howard Notman	C. E. Olsen
Ernest Shoemaker	John D. Sherman, Jr.
Herbert F. Schwarz	

Nominating Committee

H. G. Barber   John D. Sherman, Jr.

Frank E. Watson

Mr. Davis protested against his nomination for the presidency but was overruled by the chair. In the absence of other nominations, the Secretary, on motion duly seconded and carried, cast an affirmative ballot for the nominees of the committee.

Mr. Bird, in resigning the chair to Mr. Davis, commented on the approbation of the JOURNAL expressed at the recent meetings, and its value in bringing to light the knowledge possessed by its contributors.

Mr. Davis thanked the members present for the honor conferred upon him and expressed his regret that so many were absent; in most cases by reason of illness.

Mr. J. R. de la Torre Bueno was elected a member.

Dr. F. O. Holmes spoke on the subject, ''Methods for the study of the genus *Oncopeltus* (Heteroptera),'' and showed specimens of eggs, nymphs, and adults of *Oncopeltus fasciatus* from colonies maintained in small glass cages in the laboratory in the absence of green plants. Dry milkweed (*Asclepias*) seeds are furnished for food, and inverted tubes of drinking water are supplied. The insects drink water and feed on the dry seed eagerly, multiplying abundantly in the confined quarters. When numerous the insects present all stages of development simultaneously, and form brilliant exhibits for life history demonstrations.

His remarks were discussed by several members, Mr. Barber especially describing his results from winter sifting and early spring collecting which led him to believe that many Heteroptera overwinter as adults.

MEETING OF FEBRUARY 5, 1929

A regular meeting of the New York Entomological Society was held at 8 P. M., on February 5, 1929, in the American Museum of Natural History; President Wm. T. Davis in the chair with sixteen members and nine visitors present.

Henry Bird became a life member.

Aminadov Glanz, 164 Ross St., Brooklyn, was proposed for membership by Mr. Angell.

The death on January 15, of Prof. Edwin E. Calder, of Providence, R. I., a member of the Society for many years, was announced. Dr. Calder was in his 76th year, Dean of the Rhode Island College of Pharmacy, and a student of Coleoptera, particularly *Cicindelidæ,* in which family he had described three species.

The death on January 19, of Col. Wirt Robinson, of Wingina, Virginia, a contributor of many items to the New York List of Insects, who had frequently entertained several members of the Society at his home in the West Point Military Academy, where he was professor of Chemistry, Mineralogy and Geology until October 16, 1928, was spoken of by Mr. Davis. Col. Robinson was born October 15, 1864, in Virginia, graduated from the Military Academy in 1887, and served in the U. S. Army until he was retired for age. During his service of forty-five years in the Army he was not only a versatile student but also an indefatigable collector. His private museum at Wingina, built by himself, was filled with personally prepared specimens of archæology and zoology which have been bequeathed to the U. S. National Museum.

Dr. Lutz spoke of the death of Dr. Harrison G. Dyar, at Washington, D. C., and recalled his long service on the Publication Committee of the Society.

Dr. S. Parfentev presented a paper, ''Notes from Russia,'' which was read by Dr. Hartzell. This paper, giving a comprehensive view of Entomology, in all its branches, in Russia, will be printed in full.

Mr. Wm. A. Hoffman read a paper, illustrated by lantern slides, entitled "Notes on Haitian Anopheles." He showed a map of the places visited, described the methods of study, and the character of the breeding places, illustrating the latter especially by views showing what he termed "man-made" homes for the larvæ. Some of the larval characters by which the malarial mosquito was recognized were shown.

Mr. Notman exhibited *Asaphidion flavipes* Linn. collected in numbers under shingles at Bowne Avenue and Northern Boulevard, Kissena locality, Queens, Long Island, in May, by Kenneth W. Cooper and A. Killen.

Mr. Leng exhibited "A Revision of the North American species of Buprestid Beetles belonging to the genus *Agrilus*" by W. S. Fisher which adds six species, viz.: *champlaini, arcuatus* subsp. *torquatus, juglandis, 4-impressus, viridis* subsp. *fagi,* and *celti,* to the New York State List.

Mr. Mutchler reported on the special meeting of December 30 attended by 130 persons and expressed the thanks of the Committee to the American Museum of Natural History, to Dr. Moore, Dr. Horsfall, and the following ladies whose presence contributed to the success of the event: Miss Alexander, Miss Bird, Mrs. Brues, Mrs. Burns, Dr. Dobroschky, Mrs. Hartzell, Mrs. Horsfall, Mrs. Melander, Mrs. Moore, Mrs. Chris. Olsen, Miss Dorothy Olsen, Miss Ruth Olsen, Mrs. Schwarz.

Thanks were also due to the Museum for loaning dishes and taking care of ordering cakes, tea and the accessories which go with them, and to Mrs. Snow for loan of silverware.

Mr. Davis exhibited three specimens of Lepidoptera which for twenty-five years had been uncovered in a vertical bookcase without dermestid damage.

Mr. Mutchler concurred in the opinion that insects are less liable to such damage on a smooth vertical surface. He also spoke of the deciduous mandibular cusp in *Otiorhynchidæ.*

Mr. Angell spoke of the European *Anomala ænea* having been found at Engelwood Cliffs.

MEETING OF FEBRUARY 19, 1929

A regular meeting of the New York Entomological Society was held at 8 P. M., on February 19, 1929, in the American Museum of Natural History; President Wm. T. Davis in the chair with sixteen members and six visitors present.

The Publication Committee reported Dr. Willem Rudolfs as the speaker at the next meeting.

Mr. Aminadov Glanz, 164 Ross St., Brooklyn, was elected a member of the Society.

Mr. Notman under the title "Coleoptera from Southern Utah" described the localities in which he had collected, illustrating his descriptions with stereopticon views from his own photographs. The elevations varied from 3,700 to 9,300 feet and there were also variations in the local environments, though each was near water if possible. Mr. Notman's collecting was

especially designed to produce the species of the genus Bembidion, of which he has made a close study. The characters by which the species were separated were shown by blackboard drawings and explained verbally. Three boxes of excellently mounted and labeled specimens were shown.

Mr. Chapin showed living specimens of *Galerita* and *Lucanus* collected a few days ago.

Mr. Davis exhibited specimens of Cicada recently described by him in our JOURNAL, calling attention especially to forty-two specimens of *marevagans* received from Dr. Beamer only fifteen days after it had been described.

MEETING OF MARCH 5, 1929

A regular meeting of the New York Entomological Society was held at 8 P. M., on March 5, 1929, in the American Museum of Natural History; President Wm. T. Davis in the chair with seventeen members and six visitors present.

The Program Committee reported Mr. Barber as the speaker at meeting of March 19, 1929.

Dr. Willem Rudolfs spoke on "The Composition of Water and Mosquito Breeding." After pointing out that the mosquitoes were observed to breed in one pool and not in another, apparently not dissimilar, he detailed the experiments of the past five years to ascertain the ultimate cause of the difference.

1. It has been contended that the reaction of water was responsible. We find that mosquitoes will breed practically in all natural waters if sufficient food supply is present.

2. The chemical composition of the water is as a rule no factor provided sufficient food is present.

3. Whenever microscopic animals (diatoms, protozoa) and plants (fungi) are low, breeding is absent.

4. Breeding occurs with high and low numbers of bacteria.

5. The type of decomposition of the organic materials present in the water or at the bottom of the pools stimulates the growth of certain plankton organisms, which is in turn food for the mosquito larvæ.

6. If the type of decomposition is changed or hampered mosquito breeding is absent or the larvæ are stunted and do not emerge.

7. Feeding the larvæ on a diet of pure cultures of certain microscopic animals they remain alive for a long time but do not emerge. Feeding them on other pure cultures they grow fast and emerge quickly.

8. This lack of emergence coincides with an entirely different behavior of the larvæ—they react differently to light, etc.

9. Mosquitoes fed on "one-sided" food lay unfertile eggs.

10. Since specific substances either present in the water or produced by the decomposition of vegetable matter seem to be responsible for the growth of microorganisms and subsequently for the breeding of mosquitoes it follows that an entirely new method of mosquito control can be worked out.

Dr. Felt and Messrs. Angell, Bigelow, Bromley, Weiss and Davis joined in the subsequent discussion, the latter recalling the Sulphur Bacteria, Beggiatoa, found in Salt Meadow creeks, and unfriendly to mosquito larvæ.

Mr. Angell exhibited the ant *Camponotus pennsylvanicus* and photographs of a pine tree, in which they were working, and which was blown down at Cooks Falls, N. Y., on November 19 last.

Mr. Bromley and Mr. Davis discussed the migration of *Anax junius;* abundant at Lake Worth, Florida, December 23. Mr. Davis recalled its sudden appearance on Staten Island one year on March 30, 1907.

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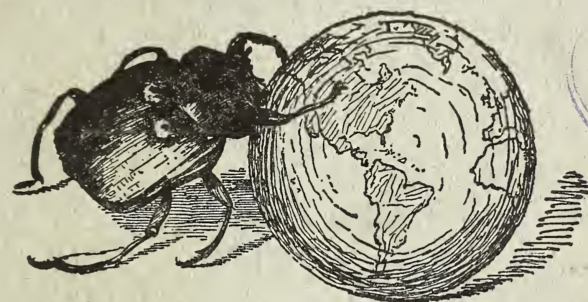
OF THE

NEW YORK ENTOMOLOGICAL SOCIETY

Devoted to Entomology in General



SEPTEMBER, 1929

Edited by HARRY B. WEISS

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JOURNAL

OF THE

New York Entomological Society

Vol. XXXVII September, 1929 No. 3

LETTERS OF E. A. SCHWARZ

The letters written by the late Dr. E. A. Schwarz are so full of entomological knowledge presented in a most intimate and entertaining manner, that the publication committee of the New York Entomological Society feels especially fortunate in being able to publish a considerable number of them in the pages of the Journal.

A request for such letters printed in *Entomological News*, December, 1928, met with immediate and enthusiastic cooperation. Dr. L. O. Howard made a careful selection of those contained in the files of the United States Bureau of Entomology and obtained Dr. Marlatt's permission for their publication, while Herbert S. Barber sent those received by him, and most fortunately found among Schwarz's effects the wonderful letters written by Schwarz to his intimate friend, Henry G. Hubbard. The letter to Herbert S. Barber reproduced in facsimile on plate VII is an excellent example of the characteristic very small but distinct penmanship of Dr. Schwarz.

Dr. Walther Horn of Berlin sent copies of the early letters written, 1866 to 1872, to G. J. H. Gerhardt and to the eminent Dr. Kraatz.

Dr. H. C. Fall loaned several letters addressed to himself and a few others written by Schwarz to Frederick Blanchard, while Frank Walters, the book dealer, kindly loaned the Schwarz letters contained in the portfolios of Mrs. Annie Trumbull Slosson.

Miss Hazel Gay, assistant librarian of the American Museum of Natural History, and her colleague Miss Margaret Titcomb, have earned our heartfelt thanks by typing the entire series of letters in preparation for the printer.

The various letters selected for publication have been arranged and are published in chronological sequence.

John D. Sherman, Jr.

E. A. Schwarz an G. J. H. Gerhardt

Breslau 11.6. 69.

Geehrter Herr,

Hoffentlich werden Sie mir es nicht übel nehmen, wenn ich mir erlaube, Ihnen beifolgend eine Probe der corsischen Käfer schicke, welche theils mein Bruder in Ajaccio gesammelt, theils mir von meinem Correspondenten, Herrn Manès, aus Corsika zugeschickt worden sind. Es sollen aber nur vorläufige Proben sein und zwar nur solcher Arten, welche ich in Ihrem Cataloge nicht angestrichen fand und wenn Sie auch inzwischen von H. v. Kiesenwetter und auch von mir einige Arten der Sendung erhalten haben werden, so wird doch der grösste Theil davon in Ihrer Sammlung noch nicht vertreten sein.—Im Allgemeinen sind die von meinem Bruder gesammelten Käfer diesmal in besserem Zustande angekommen, als dies bei seinen früheren Reisen der Fall war, wenngleich bei manchen guten Arten wie z.B. Harpalus ovalis, Drypta distincta die meisten Exemplare mehr oder weniger zerbrochen sind. Was die Qualität der ca. 3000 an Zahl gesammelten Käfer belangt, so sind meine Erwartungen in Anbetracht dessen, dass ein Nichtentomologe gesammelt hat, bei weiten übertroffen worden; was könnte ein geschulter Entomologe und erfahrener Sammler nicht dort leisten? Das Bestimmen der Käfer unterliegt natürlich grossen Schwierigkeiten schon aus dem Grunde, weil as fast unmöglich ist, die nothwendigen literarischen Hülfsmittel vollständig zur Hand zu haben. Damit Sie ein ungefähres Bild der Fauna von Ajaccio erhalten nenne ich folgende Arten, die ich bis jetzt bestimmt habe: . . . .

Im Ganzen sind es gegen 400 Arten unter denen Atranus collaris unstreitig das interessanteste Thier ist; diese Art scheint von den corsischen Entomologen seltsamer Weise übersehen zu werden trotz der auffallenden Sculptur und Behaarung der Flügeldecken, denn in den Catalogen zweier Sammler aus Ajaccio finde ich den Atranus nicht angestrichen und doch sendet mir H. Manès ein Exemplar unter einer Menge anderer unbestimmter Käfer. Überhaupt sind unter diesen unbestimmten Käfern einige sehr interessante, z.B. ein Adelops, jedenfalls noch unbeschrieben, einige sehr auffallende Scydmaenusarten,

ein sehr ausgezeichnetes Ptilium (oder Panaphantus?). Die übrige Sendung von H. Manès enthält diesmal nicht viel neues für mich wohl aber ein sehr schönes Tauschmaterial so z.B. freut es mich sehr, Ihnen ein Stück des prachtvollen Pachypus cornutus geben zu können. Leider sind viele Stücke der Sendung durch unsauberes Aufstecken und zaunpfahlähnlichen Nadeln fast gänzlich unbrauchbar. Als grosse Seltenheiten dieser Sendung möchte ich erwähnen Hydaticus Leander, Pachypus cornutus ♀ und Xanthochroa Raymondi.—Es bleibt mir noch übrig, über den Erfolg meiner Pfingstexcursionen um Liegnitz zu berichten: Am 15ten Mai war ich in Schönborn, fing aber des schlechten Wetters wegen nichts von Bedeutung, am 16ten ging ich mit meinem Bruder an das Katzbachufer oberhalb Tivoli: die schönen Uferwiesen waren vollkommen todt, hingegen sammelten wir durch Abgiessen der Ufer unter vielen Tachys, Bembidien, etc., einen Trechus longicornis; am 17ten siebte ich eine halbe Stunde am Eisenbahnteich und fand Hygronoma dimidiata, 1 Flyobates nigricollis, 1 Hylastes Trifolii; am 18ten machte ich mit Dr. Joseph die Excursion in die Hessberge, wobei es uns nicht gelingen wollte Sie zu treffen; in dem Graben oberhalb Schlaup fanden wir Agabus guttatus hf., silesiacus hf., chalconotus, paludosus s., didymus 2 Ex., Hydroporus nigrita, halensis. Durch diesen Fang aufgehalten kamen wir erst gegen 11 Uhr in den Buschhäusern an und stürzten uns sofort in die Saugruben, doch war trotz des eifrigsten Klopfen und Kötschern's auf den schönsten Sträuchern und Wiesen nichts Besonderes zu fangen; im Bache konnten wir nicht suchen, weil der Müller die Mühle arbeiten liess und folglich sehr viel Wasser im Bache war; das Aussieben der Weiden oberhalb der Mühle war fast gänzlich resultatlos, ich fing ein Cephennium thoracicum, 1 Acalles Lemur und einige Scydmaeniden. Darauf verfolgten wir den Bach oberhalb der Mühle und gingen dem rechten Arm des Baches nach: dieses feuchte Thal zeigte sich ergiebiger, doch konnten wir der vorgeschrittenen Zeit wegen nicht lange dort verweilen. Telephorus paludosus war nicht selten, ausserdem fing ich Philonthus intermedius und 2 Amphicyllus globiformis. Schon um 3/4 5 Uhr mussten wir aufbrechen weil der Zug nach Breslau schon um 3/4 7 von Brechelshof

abfährt Im Allgemeinen war der Mangel an Käfern im Gegensatz zu dem früheren Reichthum in den Hessbergen ungemein auffallend. Nachdem Dr. Joseph abgefahren war, ging ich nochmals in den Brechelshofer Park zurück, wo ich eine alte Pappel fand, in deren Mulm eine kleine gelbe Ameise (Lasius flavus?) sich befand; hierunter fand ich Euplectus gracilis und 2 Symbiotes pygmaeus; letzteres war für meine Sammlung neu.—Von den hiesigen Entomologen lässt sich nicht viel berichten; Letzner ist während der Pfingstfeiertage nicht auf Excursionen gewesen, Dr. Joseph will während der grossen Ferien mit mir einige Tage aufs Riesengebirge gehen und fährt im August nach Paris.—In der Schachtel steckt auch noch die Homalota alpestris, die sie bei mir vergessen hatten mitzunehmen.—Jetzt leben Sie wohl, hoffentlich erfreuen Sie mich bald durch einen Brief!

Ihr freundschaftlich ergebener

EUGEN SCHWARZ.

E. A. Schwarz an G. Kraatz

[ohne Datum (1869?)]

Geehrter Herr Doctor!

Wenn es einerseits nicht zu leugnen ist, dass ich sehr unrecht daran gethan habe, Ihnen bis jetzt nicht zu schreiben, so ist andrerseits mindestens ebenso unzweifelhaft, dass Entschuldigungen an der Sache selbst nichts ändern werden und dass es also am besten ist, mich sogleich in medias res zu stürzen. Um zuerst die Geschäftsangelegenheiten zu ordnen, komme ich zuerst auf die Ihnen geschickten 4 Thaler; hierbei hatte ich in der Eile vergessen auf der Postanweisung das Nöthige zu vermerken: 2 Thaler davon, sind von Letzner pro 1869 und 2 Thaler von mir entweder pro 1868 oder 1869; ich weiss nämlich nicht ob ich für 68 schon gezahlt habe oder nicht. Was die Bembidien betrifft, so lebte ich der festen Überzeugung, dass Sie diese Sache längst vergessen hätten; es thut mir leid, dass ich Sie hierin habe so lange warten lassen und bitte, mir die Schachtel bei Gelegenheit nebst Rechnung zu schicken.—Seitdem ich auf eignen Füsses stehe, ist mein Geldbeutel eher dünner als dicker geworden und ich kann vorläufig an Bücherkäufe weniger denken als je; obgleich mir hier die Bibliothek des schlesischen Vereins

für vaterl. Cultur zu Gebote steht und mir Dr. Joseph mit grosser Freundlichkeit seine Bibliothek zur Disposition gestellt hat, so ist mir doch der Mangel an eigner entom. Literatur sehr drückend. Vorläufig aber kann ich, wie gesagt nicht daran denken mir grössere ent. Werke wie z.B. die Naturgesch. d. J.D. zu kaufen. Hingegen wäre ich nicht abgeneigt noch eine Partie Sareptaner zu kaufen, vorausgesetzt, dass ich solche zu einem billigen Durchschnittspreise erhalten könnte.—

Um nun meine entom. Erlebnisse während des verflossenen Winters zu erzählen, so muss ich vor Allen mein Bedauern aussprechen dass ich bei meinem Scheiden von Berlin mich von Ihnen niche empfehlen konnte; als ich eines schönen Tages zu Ihnen gehen wollte erfuhr ich zu meinem grossen Erstaunen, dass Sie nach der Türkei abgereist wären. In Breslau häuslich eingerichtet machte ich zuerst die genauere Bekanntschaft mit Dr. Joseph, da wir uns früher nur sehr flüchtig kennen gelernt haben. In Dr. Joseph's ziemlich bedeutender Sammlung hatte ich vor allen Gelegenheit, das wirklich kolossale Material an Höhleninsecten zu bewundern, von denen ich einen Theil noch mit habe aufkleben helfen. Besonders interessant sind die Reihen von Sphodrus wobei man die Übergänge von Sph. Schreibersii und Schmidtii sonnenklar erkennt, ganz abgesehen von einigen Schaufuss'schen Arten, welche mehr oder minder nur einzelne Formen des Schreibersii sind (z.B. Sph. Erberi); in gleicher Weise zeigen die Anophthalmus eine ausserordentliche Neigung zur Variation. Dr. Joseph ist meiner Überzeugung nach der einzige der seinem Material nach im 'Stande ist durch eine Monographie jede Artenmacherei bei Anophthalm. und Sphodrus abzuschneiden. Fast noch schönere Sachen als in den Grotten selbst hat Joseph in den Vorhallen derselben aus Laub und Erde gesiebt z.B. einen Scydmaeniden, den ich zur Gattung Cephennium stellen möchte, aber 3 Mal so gross wie C. thoracicum; am meisten imponirt mir ein kleiner Rüsselkäfer von der gewöhnlichen Höhlenfarbe aber mit deutlichen Augen. Von seinen auf den Krainer Alpen gesammelten Käfern fiel mir Lixus cylindricus auf, ferner Carabus montivagus; beide waren neu für die deutsche Fauna. Die anderweitige Sammlung Dr. Joseph's ist weniger erfreulich, so weit ich dies beurtheilen konnte,

wimmelt es darin von falschen Bestimmungen. Herrn Letzner fand ich ebenso verschlossen wie früher; man kann nur des Sonntags zwischen 11 u. 12 Uhr zu ihm gehen und wird um Punkt 12 Uhr herausgeworfen, dennoch habe ich den grössten Theil seiner an schlesischen Käfern überreiche Sammlung genau durchsehen können; ein Umstand fiel mir dabei auf: Letzner steckt nämlich fast sämmtliche Käfer ohne jede Patriaangabe in seine Sammlung, was um so bedenklicher ist, da Letzner auch sehr viele nichtschlesische, deutsche und europaeische Arten besitzt. Sehr überrascht war ich bei Letzner eine ausgezeichnete ent. Bibliothek vorzufinden, nur borgt L. nichts davon weg. Letzner arbeitet übrigens an einer schlesischen Fauna die sehr voluminös zu werden verspricht und entschieden für die deutsche Fauna viel Neues bieten wird, so hat z.B. L. für Schlesien 85 Apionen verzeichnet darunter einige von Thomson beschriebene.

Dagegen arbeitet Letzner ganz entschieden dem Bestehen der ent. Section der schlesischen Gesellschaft für vatrl. Cultur entgegen, wie ich Ihnen später einmal erzählen will; die Sitzungen der Section sind ohnehin äusserst spärlich besucht; ausser Dr. Joseph ist nur Dr. Wocke und Dr. Schneider (N.B. Schneider hat die Euryusa Wockii an Dr. Joseph gegeben und dieser behauptet es wäre keine Euryusa) und ich anwesend. Dr. Schneider hat sich von der Entomologie zurückgezogen und sammelt vorläufig Brandpilze; wie lange ist noch nicht ausgemacht; vielleicht kehrt er noch einmal zur Entomologie zurück, da er alle 5 Jahre etwas neues zu sammeln anfängt.—Zu einigen kleineren Käfersammlern bin ich aus Neugierde gegangen habe aber nur mehr oder minder verlauste Sammlungen mit dicken Nadeln, Anthrenenlarven, etc., gefunden; dafür quälen mich aber diese Leute entsetzlich, indem sie mir grosse Kasten voll schmutziger Käfer zum Bestimmen aufdrängen.—Meine entomol. Studien lassen sich dahin zusammenfassen dass ich vor Weihnachten die Otiorhynchiden von Seidlitz vorgenommen habe und mich bei dieser Gelegenheit in die Systematik der Rüssler etwas eingearbeitet habe; die Artenbeschreibung bei Seidlitz hat mir weniger gefallen, indem einzelne Beschreibungen fast nur aus Vergleichungen mit anderen Arten bestehen ohne etwas Positives zu bieten; das Buch wimmelt übrigens von sinnentstellenden

Druck- und Schreibfehler; nach Weihnachten habe ich mich mit Halticiden beschäftigt und mich dabei über Allard geärgert, der in der Beschreibung oft das wieder aufhebt, was er in der Diagnose gesagt hat. In Joseph's Sammlung fand ich übrigens eine unbeschriebene Podagrica, der fuscicornis nahe stehend, welche aus dem Innern Russlands stammt, und die ich Ihnen gelegentlich mittheilen werde.—

Was Excursionen anlangt, so bin ich mit Dr. Joseph im Herbste einige Mal bei Breslau sammeln gegangen; eine projectirte Winterreise nach dem Riesengebirge kam leider nicht zu Stande, sondern nur zwei Spätherbstexcursionen in die Vorberge bei Waldenburg und Jauer, die sehr erfreuliche Resultate lieferten. Eine interessante Beobachtung machte ich dabei: in einem Bache bei Jauer leben Hydroporus platynotus und ovatus ziemlich häufig; diese beiden so nahe stehenden Thiere haben doch sehr verschiedne "moeurs"; hebt man nämlich einen der halb im Wasser liegenden Steine auf, so schwimmt H. ovatus, der im Wasser prächtig roth aussieht, schnell fort, während H. platynotus im Vertrauen auf seine unscheinbare mit den schwarzen Basaltsteinen übereinstimmende Farbe, unbeweglich bleibt, so dass man ihn sehr leicht übersieht; auch stellt er sich lange Zeit todt, wenn man ihn aus dem Wasser nimmt. Während der Weihnachtsfeiertage was es so warmes Wetter dass ich bei Liegnitz einige Excursionen machen konnte, wobei ich unter andern Erirhinus Maerkelii erbeutete. Während der Osterferien habe ich mit Gerhardt sehr fleissig bei Liegnitz gesammelt und hauptsächlich nach dem neuen Lathrobium Letzneri Gerhardt gesucht, dessen Beschreibung Sie wohl schon in den Händen haben werden, und auch in ziemlicher Anzahl erbeutet, wobei das überraschende Resultat zu Tage kam, dass L. Letzneri nächst fulvipenne das häufigste Lathrobium bei uns ist; viel seltener ist L. boreale und noch seltener L. elongatum. In meiner Sammlung fand sich übrigens eine ganze Reihe des L. Letzneri aus Madgeburg vor. Während dieses Sommers denke ich das Riesengebirge gründlich zu exploriren, da die neue Gebirgseisenbahn eine Excursion in das Hochgebirge zu einer Sonntagspartie gemacht hat.—Durch Tauschverbindungen hat meine Sammlung einen bedeutenden und theilweise ganz unerwarteten Zuwachs

erhalten; erstens traf von Bugnion eine grosse Kiste Alpenkäfer ein, worunter Catops Bugnioni Tournier (beschrieben in den Annales d. l. Soc. de F. von 1868 od. 69) hervorzuheben ist. Eine zweite sehr lohnende Tauschverbindung erhielt ich auf folgende seltsame Weise: Wie ich Ihnen früher mitgetheilt habe ist mein älterer Bruder leider brustkrank geworden und musste den Winter über nach dem Süden gehen und zwar nach Ajaccio auf Corsica. Natürlich unterliess ich nicht, ihn entomologisch auszurüsten. In Ajaccio machte mein Bruder die Bekanntschaft eines dort einheimischen Entomologen, welcher mit mir in Correspondenz und Tausch getreten ist, trotz der mannigfachen durch die weite Entfernung verursachten Schwierigkeiten; ich habe dem Corsikaner bereits 2 Sendungen gemacht und schon selbst im Februar eine bedeutende Zusendung Käfer zum grössten Theil corsikanische erhalten, nicht weniger als 200 für mich neue Arten, worunter viele, die Sie sogar als nicht ganz unbrauchbar erklär en würden. so vor allen 3 Stück des Pachypus cornutus ♂ und hauptsächlich ein ♀ dieser Art; ausserdem unter andern: Carabus Genei, Pterostichus ambiguus, Nebria Lareynei, Harpalus incisus, hirsutulus, ovalis, Bellieri, 4 Arten Percus, Agabus cephalotes, Hydroporus discretus (N.B. Der Hyd. den ich von Ihnen als discretus erhielt ist jedenfalls nicht richtig bestimmt), Lareynei, limbatus, 6-guttatus, einen neuen Sunius, Micropeplus fulvus, Merophysia formicaria, Parnus striatellus, Triodonta cribellata, Anomala rugulosa, Asida corsica, carinata, Pimelia Payraudi, Pachybrachys cinctus, Gonioctena lineata u.s.w.; viele Arten darunter in Mehrzahl.—Eine zweite Sendung aus Corsika werde ich in nächster Zeit erhalten und im Mai wird mein Bruder mit den unter Anleitung des erwähnten Sammlers gesammelten Käfern—mein Bruder schreibt von mindestens 20,000 Stück—hier eintreffen.—Einer meiner Vettern hat mir aus Syrien wieder einige Käfer mitgebracht worunter am auffälligsten ist eine ziemlich grosse hellbraune Elaphocera, die ich Ihnen, falls sie sich nicht als europäisch entpuppt, überlassen werde.—Ihr Verzeichniss der deutschen Käfer hat mich sehr interessirt; ich vermisse übrigens bei flüchtiger Durchsicht: Exocentrus Clarae resp. punctipenne (bei, Liegnitz an Eichenzäunen) und Thyamis Reichei (von Gerhardt bei Liegnitz gefangen).—

Zum Schluss noch eine Angelegenheit: Ich habe Letznern beredet, Mitglied der société ent. d. Fr. zu werden; da er nun in Paris kein Mitglied kennt, so hat er mich gebeten, Ihnen die Sache vorzutragen mit der Bitte, falls es Ihnen nicht viel Mühe kostet das Nöthige zu arrangiren.—

Schliesslich bitte ich Sie um Entschuldigung, dass ich Ihnen einen so langen Brief noch dazu in meiner miserablen Handschrift schicke.

In der Hoffnung, dass Sie mir auf die oben angedeuteten Fragen gelegentlich Antwort zukommen lassen verbleibe ich

Ihr freundschaftlich ergebener

EUGEN SCHWARZ.

United States Department of Agriculture,
Division of Entomology,
Washington, D. C. January 21, 1889

My dear Mr. Sherman,

I cordially thank you for the specimen of *Hister planipes* and that of *Bactridium cavicolle* which you kindly sent me and which were correctly named.

The reprint of LeConte's & Horn's "Classification of the Coleoptera of North America" is now ready and you can obtain a copy for $2.66 (which includes postage) by addressing Dr. Geo. H. Horn, 874 North 4th St., Philadelphia, Pa. Try by all means and bring this sum up because without the *Classification* the study of our Coleoptera is impossible.

Yours sincerely,

E. A. SCHWARZ

United States Department of Agriculture,
Division of Entomology,
Washington, D. C. Jan. 30th, 1890

Dear Mr. Sherman,

Your favor of the 19th and the specimens came safely to hand. Many thanks for the specimens of *Agabus obtusatus* which were quite acceptable. The others are herewith returned and I enclose that list of them. No. 2 (Mycetochares fraterna) is not

common, in fact all species of Mycetochares are very little seen in collections. They live in dry-rotten wood and crawl about during the night. To fill up the box I added a few western species which are possibly new to you.

The Lathrobium abdominale in my last list should be changed to *L. ventrale.* Mr. Schmidt is still at 290 3rd Ave., Brooklyn, but since the old man does not understand English it is quite likely that he will not write to you. If you want boxes order them through his son, Prof. J. B. Smith, Rutgers College, New Brunswick, N. J., but you will not get any before May since several hundred boxes have been ordered by other parties.

The Washington Entomologists are crawling about again.

Yours sincerely

E. A. SCHWARZ

Washington, D. C.
Feb. 26/90

My dear Mr. Sherman,

I sincerely thank you for your kindness in presenting me that specimen of *Euplectus.* I have most of the species described by Casey and LeConte but nothing similar to your species. It is probably undescribed. Your last box came safely to hand and I returned it yesterday, the list is inclosed and in the space made empty by taking out the Euplectus I put two western Staphylinidae. No. 35, (*Stenus ageus*) is not common in my experience. The genus *Stenus* is a difficult one anyhow and rendered much more difficult by Capt. Casey's poor paper thereon. The genus Cafius differs from Philonthus in the structure of the hind tarsi, the first joint being but little longer than the second. Cafius has always on the thorax two dorsal series composed of many punctures and the lateral punctures are also numerous; in most Philonthi there are but few lateral punctures and not more than 6 punctures in the dorsal series. Cafius consobrinus must be a clerical slip for *C. sobrinus*; you can readily recognize this by the yellow apical border of the elytra. You can get a good and suitable lens for about 4 or 5 dollars but only in Philadelphia or New York. There is none to be had here in Washington and I suppose still less in your city. Such lens is of course

not so clear as a Tolles triplet but almost as strong. I had lately a number of locality labels printed and as I had just a column to spare I printed Peekskill labels. I send you herewith some and can send many hundreds more if you find them convenient.

Yours sincerely,
E. A. SCHWARZ

Washington, D. C., March 26/90

Dear Mr. Sherman,

I cordially thank you for sending me your only specimens of *Philonthus micans* and *Teretrius americanus* but since I have both and since I wrote you only that I would like to have specimens thereof I decline to deprive you of them and they are herewith returned. Your other specimens are herewith returned with list of names. There are several rare ones among them: × – Bryaxis lunigera ♀; the ♂ is very rare and the female is still rarer. I have a few males but no female and should be very glad to get it from you as well as the Mycetochares. 9–914, Nemosoma parallelum, is tolerably rare; 9–900 is a strictly maritime species but not rare in the more northern Atlantic States; 9–918, Thysanocnemis fraxini is not often seen in collections and lives in the seeds of Fraxinus; 8–783, Trimium globifer, is also rare and I have only one specimen.

You may send me everything for determination excepting large western Tenebrionidae, Cerambycidae and the larger Carabidae; if you send species of such genera as Melanotus, Macrops, Anthonomus, Atomaria, Baris, etc., they will in most cases be returned unnamed since these genera are still in great confusion.

For mounting specimens for my collection I use a mixture of Bleached Shellac Varnish and common Shellac Varnish, both being sold in small vials. Formerly I used only Bleached Shellac Varnish which is perfectly white but I found that it has no adhesive powers and was compelled to add about one-third of common Shellac Varnish. Since an exceedingly small quantity of this mixture is sufficient to hold the specimens firmly to the paper, the dark color of the mixture does not interfere with the

clear appearance of the mounted specimen. For mounting duplicates a gum soluble in water is absolutely necessary and I use since many years Spaulding's glue with great satisfaction. In remounting duplicate specimens I throw the paper in cold water and wait until the specimens float off and are a little softened; then I take them carefully out of the water and place them on wet blotting paper which takes off the still adhering particles of the glue. Specimens received dry in papers I simply throw in cold water, smaller specimens are sufficiently relaxed in from 5 to 10 minutes (according to the temperature of the water) but large specimens e.g., Eleodes, etc., must be left in the water for half a day or so.

Yours sincerely,

E. A. SCHWARZ

P. S. Please direct in future your letters to my private quarters.

230 New Jersey Ave., Northwest.

United States Department of Agriculture,
Division of Entomology,
Washington, D. C. April 9th, 1890.

Dear Mr. Sherman,

The post office has a right to open 4th class mail matter and we should not be astonished, therefore, that once a while a package of insects suffers by such inspection. I have had several times occasion to mourn the loss of valuable specimens from this cause.

I am very much obliged to you for the new *Mycetochares* and the female of *Bryaxis lunigera* and sincerely hope that you will be able to find additional specimens. I send you a male of the latter species and call your attention to the wonderful formation of the antennae in this sex. I also add three other Pselaphidae and hope they may be new to you.

I return herewith your specimens which this time are, in some instances, determined with a ?, viz., in the genera *Batrisus* and *Hydroporus*. The former genus has fallen into great confusion by the reckless way in which Capt. Casey has described "new" species. The genus *Hydroporus* has always been a difficult

genus and every large collection contains many doubtful and unnamed specimens. I have No. 8–604, *Coelambus* and believe it to be undescribed; No. 7–397 belongs to a group which is still in confusion and I think that your specimen I is only a strongly pubescent form thereof. No. 7–1032 a Bryaxis divergens is not often seen in collections but may be not rare with you; you can recognize it by the striae on the first abdominal segment which are approximate, divergent *and arise from a rounded tubercle.* No. 9–929, *Philonthus thermarum,* is a rare species and I have hitherto seen specimens only from Washington, D. C.; 8–587, *Hydroporus difformis*; this I have not in my collection and I would be glad to have a specimen. Try and find the ♂ which has the antennae thickened at middle. No. 7–392 this was formerly well known in our collections as *Hydroporus signatus* Mann., but Dr. Sharp has omitted this name in his Monograph for reasons not stated by him and the species has probably another name. No. 7,1032d had been lost when I received the box, but it may be still at the bottom of the box. The large *Euplectus* which I could not name in your previous box is in all probability only an exceptionally large *E. confluens* with an unusually large head.

I also send you the rest of the locality labels.

No. 4 of the Proceedings of the Ent. Soc. of Wash. will be out before the end of the month. This number will cost us about $180.00 and since we have only $75.00 in our treasury we will have to contribute heavily. It contains also my paper on Myrmecophilus Coleoptera and I hope that you will be able to make additions thereto since many common species of ants have never been properly investigated as to inquilines.

Yours sincerely,

E. A. SCHWARZ

Washington, D. C. October 27/91

Mr. H. C. Fall,

Dear Sir,

Your favor of the 20th inst. came duly to hand. I shall gladly name for you North American Coleoptera but I am afraid that you will find me of less assistance to you than such accomplished

Coleopterists as Dr. Horn and Mr. Blanchard. Still, I have also endeavored to make myself thoroughly acquainted with the literature on our Coleoptera and with the insects themselves. Of late years, however, I have paid attention almost exclusively to the Microcoleoptera of all families and somewhat neglected the families composed of larger forms. Thus, do not send me for determination any large Carabidae, Scarabaeidae, Buprestidae, Cerambycidae and especially no large Tenebrionidae. There are many Coleopterists who know these big things much better than I do. Even among the Microcoleoptera there are enough genera of which I know very little.

I do a great deal of determining for others and always make it a point to return everything that has been sent to me. If I am desirous of having a certain species for myself I ask my correspondents for a specimen or two provided they have duplicates. So, if you send me anything for determination I shall return the box as soon as practicable. Please address packages and letters: 230 New Jersey Ave. NorthWest.

Yours truly,

E. A. SCHWARZ

Selma, Ala., August 27, 1894

Dear Hubbard,

I am much obliged to you for your letter of the 24th which I found here this morning but I am greatly alarmed to learn that you have contracted such a bad case of malaria. I earnestly hope that you will have carried out by this time your plan to go to Virginia Beach or Cape May and that Mrs. Hubbard has been with you.

Since my last letter to you I did unexpectedly some observations on *Aleurodes citri* which occurs in great abundance on a little hedge of Cape Jessamine in the city of Baton Rouge. Its behavior on that plant is exactly the same as on the Orange in Florida but I succeeded in finding several enemies and notably a little black Coccinellid which appears to be identical with *Cryptognatha pusilla* Lec. This species is very rare in Florida (so far as I recollect) but common near Washington and could

be easily transported to Florida.—Mr. Morgan the Entomologist of the Louisiana Agricult. Exper. Station is a very nice fellow and if you had to go next winter or spring to California in your investigation of Orange insects you should by all means notify him and he would show you with the greatest pleasure all the Orange groves south of New Orleans. He is very anxious to make your acquaintance but you must by no means tell him that the Florida oranges are better than those from Louisiana, or that the Louisiana orange trees are badly kept.

During my trip in Texas I kept a sharp outlook for gopher holes but since I mostly travelled in the black soil region I did not see any. The Aransas peninsula with its sandy soil, its Live Oaks and other small oak shrubbery reminds one very much of Florida but the sand is only a couple of feet deep and underlayed by limestone rock. No one knows of the existence of a burrowing tortoise although there is a hole under every bush. This hole is, however, only about a foot deep and inhabited by a rabbit which is one of the greatest pests of this region and every cultivated spot is enclosed by a rabbit-proof fence.

Selma has greatly improved and increased since our stay here in 1880. The old St. James Hotel is closed and there is now near by a big bridge across the Alabama River. The latter is brim full at present and has overflowed all the low land on the other side of the river. The weather has moderated somewhat but it is raining constantly so that I cannot do any field work. I have written this to Mr. Howard and I hope he will consent to my breaking up this trip the main object of which I have accomplished.

Owing to the bad weather I have seen but few insects in the field. Only at Rockport I could not abstain from spending a few minutes at the beach of the bay. The beach is quite flat and the surf does not reach the shore; consequently there is no drift-wood etc. swept ashore, but a thin layer of ill-smelling, very fine sea-grass covers the shore for about 10 feet. On this grass there is a Cicindela in great number which I fail to recognize and under the grass I found a few beetles among them a species of Pogonus, different from that we found at the Great Salt Lake. The Aransas Peninsula is certainly a good and interest-

ing locality in April or May when everything is said to be in bloom.

I sincerely hope that you will look out for your health.

Yours ever

E. A. SCHWARZ

Hotel Albert.

Selma, Ala., September 1, 1894

Dear Hubbard,

Just returned from a trip to Pineapple (50 miles south of here) and on the point of returning north I receive your letter of the 30th ult. the contents of which greatly surprised me. Above all I can only repeat my sincere wishes that you soon get well again; secondly it is of course out of question that you must bring out your second edition of the Orange Insects Report under all conditions. I think you can accomplish this before the winter is over and then you are of course at liberty to resign your position or to make some other arrangement with the Department.

That Mrs. Hubbard has made herself at home in my rooms I learned already from a letter from Mr. Havenstein, and I hope she has, from an inspection of the rooms, seen how a bachelor's quarter is to be managed. I hope also that she got soon over her indisposition and that she has seen something of the Knights of Pythias.

I have myself a slight attack of malaria just now; I think it is that miserable Selma water with its horrid smell which did it but I shall get better as soon as I am on the railroad. All the countless Red bug bites which I got on this trip are breaking out and I am covered all over with bad sores. I intend to stay over at Mount Airy or Toccoa (north of Atlanta) for a day before returning to Washington; this will put me all right again.

Shall write more fully when I get back to Washington. I am of course greatly disappointed to know that I shall not find you there. My kindest regards to Mrs. Hubbard and to your father and brother and to all Detroit friends.

Yours ever

E. A. SCHWARZ

P. S. I hope you did not pay anything to Mr. Havenstein; my rent for August had been paid by myself.—Did you get my letter of the 27th?

Wash. D. C., Sept. 20/94

Dear Hubbard,

I intended to write to you every day but delayed it constantly because I do not know yet when I shall be able to get away from here. I have not done much work here since my return mainly for the reason that I had a pretty bad attack of the regular ague. I am over it now and my Red Bug sores have mostly healed but still suffer from utter lack of appetite. Your postal card has just come to hand, however, and I have made up my mind to leave here Sunday night (either at 7.10 or 10.40 P. M. I do not yet know which is the right train) or Monday morning 7.50 A. M. I shall stop at the Russell House, Detroit, and beg you to write me a note there how and where I shall find you.

I have, through several days, carried on a systematic search in my sleeping room for the lost diamond and regret to say that I have failed to find it. It is certainly not on the floor or under the bureau or elsewhere *on* some of my furniture but it may be somewhere *in* one of the drawers. I have given direction not to clean the room until every hope of finding the diamond has vanished.

Dr. Horn was here on Sunday and Monday; he regrets that he did not see you here and sends regards. Prof. Riley is said to have returned from Europe but has not yet made his appearance at the Department. Upon hearing of his return, Mr. Howard has escaped into the mountains of New York and will be absent until October 1st.

All my specimens I collected in the South and which I had packed in pill boxes have been eaten up by the rats in our office!!

I sincerely hope to see you and all your family in good health.

Yours ever,

E. A. SCHWARZ

P. S. I see that there is a vigorous correspondence going on between the Treasury authorities and our Disbursing Office over one of your bills for $2.00 for express. I have been twice at the Express Office to straighten up the receipt but so far it had no effect. E. A. S.

Martinet House.

San Diego, Texas, May 19, 1895

Dear Hubbard,

I should have written to you long ago, in fact I am greatly ashamed of not having done so, but there is again the same old trouble and the idea of being suspected of carrying on a secret private correspondence with you while you are in the employment of the Department bears heavily upon me.

Of course I constantly thought of you and your family during this disastrous winter and when I passed through the dead orange groves of Louisiana on my way to Texas. West of Houston the Texan prairie is strewn with dead cattle and even the mesquite bushes are killed. Here in southwestern Texas there are no fruit trees to be killed but all the oleanders and the fine Mexican plants in the gardens have been frozen. There was two days fine sleighing here in February.

I am sent here into this miserable Mesquite and Cactus brush to investigate *Anthonomus grandis* which at present is so rare that it takes three men a whole day to find a single specimen. I wonder how I can investigate it under the circumstances except by waiting until it gets more numerous.

The country is by no means handsome, a waterless region without trees, slightly rolling, densely covered with a monotonous growth of Mesquite and Chapparal (4 or 5 species of Mimosa and a few other spiny bushes.) The intervals between the bushes are filled with a liberal growth of gigantic Opuntias, but owing to the drouth there is hardly any low vegetation. East and south of here there are prairies, at present looking very much like the desert west of Salt Lake City, Utah. The soil is however very fertile and this whole region would be a garden land if irrigation were possible. Still it is astonishing that in spite of the drouth (it rains here about five or six times a year) they are able to raise some corn, cotton and beans. Farther south, toward the coast, a great deal of grapes are now raised but down there they have extremely heavy dews which replace the rain. The climate is delightful and much more invigorating than that of Florida.

Regarding the work of Scolytids in Orange trees I would say that a good deal has been written on the food of the larvae of

Xyleborus and more especially *X. dispar* (pyri). All observers agree that the larvae are not lignivorous but there is some dispute regarding the nature of the real food which by old Schmidberger has been termed "ambrosia." Whether this consists solely of fermented sap or whether it is exclusively a fungus growth or a combination of the two is, to my knowledge, not yet settled. The natural history of the Platypus is by far less known. Did you get a male of the so-called Xyleborus rubescens from the Orange? This would be quite interesting because we would then be able to see whether your species is identical with the West Indian Shot borer.

It is too bad that I cannot be with you now and have a good talk with you but I hope to find you in Washington when I get back. By all means take this opportunity of visiting California and extending your knowledge of the orange culture. Take a good look at the country out there and I hope it will present a more beautiful aspect than this southwestern Texas which for reasons unknown to me they call "semitropical Texas."

Before leaving Washington I inquired of Dr. Stejneger regarding the precise locality of *Gopherus berlandieri*. He told me that only the type specimens were known and that these came from the valley of the lower Rio Grande. I made some inquiry here about burrowing turtles but there is unfortunately no one interested in natural history. I am told that they have a turtle that burrows like a mole, never coming to the surface, and Mr. Bront gave me the shell of a turtle which is said to burrow along the banks of the San Diego River (this has, however, never any water). I send it with this; please ascertain from Dr. St. what species it is. There are so many burrowing animals here that it is difficult to know which hole is a turtle hole.

I have never been in a country like this and the fauna is quite different from that I have collected at Columbus but the Coleoptera resemble in characters those found by Belfrage in Clifton Co., Tex. I presume the real "semitropical" portion of the fauna is confined to the Rio Grande Valley. I have of course picked up many Coleoptera but have not yet learned how to collect in this spiny region. The Mesquite seems to be very rich in insects and I wish you were here to study the insects of

the Opuntias. These are infested by at least 3 large species of Acalles and lots of other things. I have reserved for myself a duplicate set of the Coleoptera and send you herewith a tin box full of them. Another box I sent the other day to Mr. Haverstein. Open the same and see whether the specimens are all right.

Dr. Horn was in Washington early this spring and he told me that Mr. Merkl of New York got hold of that new Nomaretus of yours from N. C.; so I resolved to fix up that paper on *Nom.* for publication and have stolen all your notes. I wonder what you will say to this. The paper will be published in the next number of the Proc. Ent. So. Wash. now in press. You will see that I have greatly changed the table of species which we worked out last winter.

You do not write me how your father is going on, and how is your family.

I hope you have made yourself at home in the old quarters on N. J. Ave. The rent is paid to June 1st. and since I have to pay rent anyhow after that date you have only to pay for breakfast and lager beer (I wish I had a good quantity of the latter here) I think there is also a little whisky left.

My address will be for some time San Diego, Tex., though I am just about to go into the Nuces Valley for a week or so.

Yours ever,

E. A. SCHWARZ

San Diego, Texas, May 31st, 1895

Dear Hubbard,

I have just returned from a short trip to Laredo, where I had to go on account of a periodic trouble I have with my plate of false teeth, and find here your two letters of May 23rd and 24th. I do not like at all to hear the bad news regarding your father's health but since he got over his trouble once there is reason for hope that he may get over once more and attain the ripe age of 90 years in spite of his gangrene. In regard to Mrs. Hubbard's health I know she will speedily recover in the balmy air of southern Texas where the climate is certainly admirable. No telegram has as yet come from you announcing your departure from

Washington but at any rate I am afraid it will not "function," since traveling from here to San Antonio takes just as much time as from Washington to San Antonio. The slowness of the trains and the waste of time that pervades everything here reminds me of the olden Florida ways as we found them in 1875.

I shall seriously think of joining you at Los Angeles for a couple of weeks or so after about June 20th when I propose to close my work here. At the end of my work here I am contemplating a visit to the isolated cotton belt at Del Rio which is about 170 miles west of San Antonio on the road to El Paso and only about 800 miles from Los Angeles. On the other hand I think I shall feel a little tired out with field work and desirous of returning to Washington.

The longer I am in this spiny country the more I like it and I find that it possesses many peculiar charms especially away from the towns and where cattle, goats and sheep have not spoiled its beauties. There is quite a stretch of land along the banks of the so-called Taranchuas Creek only a mile distant from San Diego which is fenced to keep out the cattle on account of the numerous steep arroyos. This piece of land preserves all the severe beauty which in former years was spread over the whole southwestern corner of this State and I wish only you could see it. I am sure there is nothing like it in the whole of Arizona and California. In the dry arroyos which are all the way from 4 to 30 feet deep one can easily walk but except at rare intervals is it possible to make a few steps in the brush itself. I am utterly unprepared for an entomological exploration of this country and should have big boots and a thick leather coat and above all I should not be sensible to the spines of all sorts. At present whenever I step in one of the gigantic cactus or put accidentally my hands upon them I pause to extricate the spines whereas the Mexicans and old Texan settlers do not mind the spines in the least. Of course, the insect fauna of this section will be found to be rich and interesting although I shall bring home only a small fraction of the species that could be found here with due preparation. Before I left Washington there was a great talk at the Department about working up the fauna of Southwestern Texas, Townsend down at Brownsville proposing to publish a big

paper, and I was assured that all my things would be properly mounted. So all the uniques are in the boxes I send to the Department and I would feel sorry if some of them got lost.

It is extremely difficult for me to advise you what you could do for Coleopterology in southern Cala. Our collection does not contain a great deal from there and thus everything with an exact locality is welcome. If you go to Santa Monica on the sea coast you would of course have a good opportunity to make a collection of the maritime fauna and I feel quite sure that rare things can be found by digging in the sand. If you spend your Sundays in the mountains there is of course opportunity to collect anywhere. If there are any streams try and extract the Elmids of which I have no doubt several new species should be found there. I am anxious to obtain specimens of the Scolytid genus *Chaetophloeus,* a rather small, *oval* species of brown color with conspicuous *erect* spines. It should occur on or in small dead branches.

I am extremely pleased to learn that you finally obtained the imago of that Gopher Lepidopter and am very anxious to learn friend Smith's opinion. I feel quite certain that it is an undescribed species and upon your return from Cala. you should by all means go to work and write an appendix to your gopher paper. I seriously doubt whether the turtle shell I sent you will turn out to be a Gopherus and further whether *G. berlandieri* really occurs at San Diego. While going to Laredo I crossed a remarkable stretch of drift sand greatly resembling that at Squally Hook, Or. This sandy region is about 5 miles across and of a length unknown to me. The station Peña lies at the western edge of it and here I inquired of a burrowing turtle. The stage driver fortunately spoke English and he informed me that there was such an animal in that sand known to the English speaking settlers as the "upland terrapin." I should not wonder if this is *G. berlandieri* although the Peña region is not exactly the lower Rio Grande valley. At Laredo the soil is either hard clay or gravel but there is no one in the city that could give me any information. The *Catops* from the gopher holes in Florida is a new species and if you have now ♂ and ♀ among them, it can be described.

Glad to hear that you do not raise any row about that Nomaretus paper; *N. hubbardi* is undoubtedly a good species; I sent a couple to Dr. Horn who affirms its validity.

I was very much afraid myself that the big Acalles would come to life again, and opened here every box before sending them to Washington. The trouble is that my cyanide I used during the first two weeks of my stay was old and poor.

Your discovery of the ♂ of that Orange Xyleborus is most welcome news to me; I shall at once examine the specimens upon my return to Wash.; please let me know where you put them.

I shall write you again shortly, but I can hardly expect to get an answer from you soon, since I expect to do some travelling now. However a letter will reach me about June 15th at the Menger Hotel, San Antonio.

Yours ever,

E. A. SCHWARZ

San Diego, Texas, June 1st, 1895

Dear Hubbard,

I fortunately kept my letter of yesterday in the expectation of getting a telegram from you but I got instead your letter of May 27th. I do not know whether or not I should feel sorry that you have abandoned the California trip but I think that under these circumstances you did right not to go.

I have been advised about that Rhinewine and beg you to at once open one of the cases and drink a bottle to the health of your father; and further to accept one case as a present from me to be sent to your folks at Detroit. Five cases contain a light white wine while the sixth contains a dozen bottles of the famous red Rüdesheimer wine which is quite expensive ($1.05 per bottle).

Very much pleased to learn about Smith's determination of the Gopher Lepidopter and more especially that it really belongs to Helia.

I sent to Dr. Horn all our Scymnus but he refused to have anything to do with the Smilias and other minute Coccinellids. Coquillett's new Smilia is by no means a very striking species but I shall describe it as well as various other undescribed species in

our collection upon my return to Washington. There is a true Pentilia in our collection from Biscayne Bay. That Dr. Horn refuses to recognize the genus Vedalia and reverts to the old genus Novius curiously coincides with Dr. Weise's (Berlin) paper on Coccinellidae in which he erects a new genus, *Neovedalia,* upon *V. cardinalis.* You will find Weise's paper either in the latest Berliner or Deutsche Entomologische Zeitschrift.

An addition to the literature on Gopher insects is furnished by Mr. Lewis of England, the specialist in Histeridae and famous traveler in Japan who published some time this spring in the Entomol. Monthly Magazine a letter from old Dr. Hamilton on your and Dr. H.'s Discoveries. The letter does not contain, however, anything new.

A letter just received from Mr. Howard changes considerably my plans for the next two weeks. He requests me to run down to Brownsville to see how Townsend is situated there. Although nothing can come out of this trip in the furtherance of this Anthonomus grandis investigation I am exceedingly pleased to have now the opportunity of seeing what they call here the "paradise of semitropical Texas" where they raise cucumbers and watermelons in December and where the rattlesnakes grow as thick as a man's thigh. I only dread that stage ride of 110 hours but while I was at Alice the other day I inspected the stage and found it quite comfortable. So I have just repacked my traps and shall commence this trip tomorrow (Sunday) at 3 P. M. to arrive at Brownsville next Tuesday in the evening. I expect to be out of sight for 8 or 9 days but letters will reach me up to June 10th at the St. James Hotel, Corpus Christi, Tex.

I learn from Mr. Chittenden that Henshaw's latest Supplement to his Check List of N. A. Coleoptera is published; please order for me 4 copies from Mr. E. T. Cresson of Philadelphia.

I sent yesterday another box to Mr. Havenstein containing various pill boxes with some Coleoptera; please take charge of the same.

If I remember correctly, there was when I left some extra good whiskey left in a bottle in the closet of my parlor. I hope you have found it.

If all goes well I hope to see you in Washington within the next four weeks.

Yours ever,
E. A. SCHWARZ

Brownsville, Tex., June 5, 1895

Dear Hubbard,

After an uninterrupted trip of 40 hours by stage I managed to reach this place. The road from Alice is less interesting than I anticipated, for instead of striking straight down through the country it proceeds in a southeasterly direction until it reaches, about 50 miles from Alice, the open prairie and salt marsh region and follows the same to within about 50 miles east of Brownsville. Then follow about 45 miles of Mesquite brush and chapparal until finally one reaches the rich black soil of the Rio Grande valley which with its numerous trees, its rivers, swamps, exuberant vegetation etc. forms the strongest possible contrast with the San Diego region.

Prof. Townsend is located here and inhabits a nice little house with an entomological work room etc. but he is unfortunately not a field entomologist and does not know how to collect in this region which must be an entomol. paradise. I wish I had been here since last April. But then the cotton districts are several miles distant from the city and can hardly be reached without wagon. I expect to stay here three or four days and then return to Alice and Corpus Christi.

Yours ever
E. A. SCHWARZ

Menger Hotel.
San Antonio, Texas, June 18, 1895

Dear Hubbard,

I find here your letter of the 6th from which I see that when you wrote it you had not yet received my letter of May 31st or June 1st. I think I wrote you also from Brownsville. During my short stay at the latter place I had the opportunity of visiting for a couple of hours the semitropical forest along the lower Rio Grande and most sincerely regretted that you were not with

me. We must under all circumstances make a coleopterol. expedition into the depth of this fairy land which so far as I could see beats everything I have hitherto seen in richness and variety of insects. The edge of this forest resembles wonderfully your prairie land at Haw Creek; the forest itself is mainly palmetto, interspersed with Celtis, Ash, numerous Mimosaceous trees and various other trees entirely unknown to me. The Erythrina grows there about 30 feet high. The whole is interwoven with a tangle of vines into a delightful rather dense jungle where unknown species of Coleoptera can be found by the score in less than no time.—After my return from Brownsville I visited for the third time the Nueces River Valley north of Corpus Christi and would by now be on my way home but for the fact that I have to investigate the watermelons at Pepper Grove which must be somewhere near Galveston. So I shall lose at least two days but expect to be in Washington by the 22nd or 23rd. It is extremely hot here, much warmer than farther south. Hoping to find you in good health etc.

Yours ever

E. A. SCHWARZ

Washington, D. C., Dec. 9/96

Dear Hubbard,

I felt greatly relieved to learn from your letter of the 4th that you had finally started on your Arizona trip, and from your letter from New Orleans which I just received I see that you will be soon in a climate where there are no blizzards and where even the Ghila monster enjoys the midwinter temperature. I feel confident that under the influence of this congenial climate the microbes in your lungs will soon get still smaller and scarcer and finally disappear altogether. I hope you will let us know at once where and how you got settled at Tucson and also what in the line of boxes, bottles, pins etc. etc. we can send you. Do not exert yourself too much at first, take it easy but spend as much time as possible outdoors. Remember also that should you get short of funds you need only to telegraph to me.

I wrote you a lengthy letter to Detroit which seems to have missed you. It contained an abstract of the entomolog. news of

the past few weeks and should it not reach you I shall set up another epistle.

Since I wrote that letter nothing of any consequence has transpired here. Last Thursday we had the regular meeting of the Entom. Society with the usual tremendous amount of talking. There was also the election of officers for 1897 and you have been reelected as Vice President.

I shall write more fully as soon as I hear from you. I wish I could be with you at this time.

Yours ever
E. A. SCHWARZ

Washington, D. C. Dec. 17/96

Dear Hubbard,

This morning I mailed you a short note (besides forwarding two letters) inquiring from news from you but upon returning home from the Office I am delighted to find your most welcome and interesting letter of the 11th. To be sure you do not write a word about the state of your health, nor how the Arizona climate agrees with you but since you are looking after the insect fauna I take this to be a good sign. Do not be discouraged at not finding any insects now; you must remember that you are in midwinter in an arid region, and, very probably, the immediate surroundings of Tucson are unfavorable. Moreover in such regions only close acquaintance with the locality will enable you to find the insects if there be any. *Larrea tridentata* should have some Coleoptera peculiar to it though none (except Aphodius larreae, in the blossoms) are on record.—The Aleochariui in fresh dung are probably not different from those (*Aleochara bimaculata* etc) we find here under the same conditions. The "little hairy globular Tenebrionid" must be an *Edrates* but the small species *E. rotundatus* is known only from Colorado and Wyoming whereas the species known from Arizona, *E. ventricosus* cannot be called "small." It is as big as a potato beetle.—The Cerambycid in Sunflower stems is probably nothing but *Hippopsis lemmiscata* but is also likely to be a Dorcasta or Spalacopsis. If you send a few stems we will try and breed the imago.—*Thyridopteryx townsendi* Riley is as far as I remember

now a MS. name but I shall hunt the subject up tomorrow.—Small Hydropori from Arizona are liable to be good species especially if they are of ovate or broadly-ovate shape. Of large Parnidae only one species *Helichus productus* is known from Arizona and this is probably your species.

Yours ever,

E. A. SCHWARZ

Washington, D. C., Dec. 21, 1896

Dear Hubbard,

I expected to get a letter from you to-day and sure enough when I came home from office I found your letter of the 16th with two packages. It is extremely gratifying to me to learn that you are satisfied with the state of your health and hope that the improvement will go on steadily. I opened the boxes and also the small pill box since I heard something crawling in it. I found that the Bruchus had come to life again and had done some damage to the tarsi of the Helichus (*productus*) and Elmis (*similis*). I shall mount tomorrow morning the contents and report to you at once. I have taken leave for the rest of the month but shall go to the office tomorrow to send you boxes, franks, paper etc. and to give Pergande the Coccid and the ants. I am sorry that you have to work so hard to get a few things but I suppose you do not need to stay at Tucson longer than it is necessary to get acquainted with the aspect of the country.

Referring to your letter of the 11th I would say that the Thyridopteryx townsendi Riley has never been described and the imago has not yet been bred although we had at several occasions living larvae here in Washington.

Insects of all orders are reported to be plentiful on Larrea when this plant is in blossom, and Coquillett informs me that he always finds the Otiorhynchid genera *Ophryastes* and Eupagoderes sitting on the stems.

Your mention of adobe houses reminds me of the fact that Cockerell found this spring, while occupying the seat of his adobe-built backhouse at Merilla, a specimen of a Meloid, which is either Hornia or a genus allied to it. I also recall that Mons.

Dugès of Guanajuato, Mex. found the only specimens of his genus Leonia (allied to Hornia) in an adobe wall. So if you find a deserted adobe house, look out for Anthophora colonies in the walls.

Pergande has become nearly crazy in consequence of the study of your Xylococcus and swears now that the family Brachysceli-dae has no existence whatever. Figures of the birch Xylococcus are now being made and your paper will be sent to you shortly to make the necessary alterations.

You remember that Cerambycid larva producing the rattle-snake-like noise we discovered in a pine stick at our house? One of these larvae has been good enough to transform to imago; it is the common blue *Callidium antennatum* which you would be able to find also in the pine woods of Arizona.

I have read with intense interest your letter of the 16th and shall reply to it tomorrow when I have mounted the insects.

Yours ever,

E. A. SCHWARZ

Washington, D. C., Dec. 29, 1896

Dear Hubbard,

Above all I most sincerely wish that with the coming New Year you will get rid of your lung trouble and return next summer in good health. I suppose you will have had a lonely X-mas, and it was very kind of you to write such an interesting letter on that day. I spent the day also very quietly; we had a tree for the children but I soon retired to my rooms and continued to work on the Coleoptera which you collected last summer at the Huron Mts., Lake Superior. I am determining these beetles very carefully and make a list of the species. I have finished the Carabidae and Staphylinidae, the two best represented families and find among them a Platynus, new to our collection (no name for it yet) and a beautiful undescribed Omalium also new to our collection and the L.S. list. The entire collection will amount to about 150 species.

I have also finished the mounting and labeling of your Arizona lot No. 1. The box labeled "Hemiptera from Larrea and Mesquite" contained two species of Capsidae, one Tingis, two

Cercopidae, two Jassidae and a very young larva of a predaceous Heteropteron allied to the Wheel bug. Among the Psyllidae from Mesquite in the capsule I find three species of *Rhinocola,* all undescribed, one being identical with that you found on Larrea and the second very remarkable on account of the long spines on head, thorax and wings. As I wrote you before, there is considerable doubt in my mind whether the Mesquite is the real food-plant.

I have prepared a complete list of your Arizona lot 1 which will be quite useful for reference upon your return.

I hope that by this time you will have received the box of supplies sent by express, and my two letters referring to your lot No. 1 and the envelope with packing paper. Another of your tin boxes is returned herewith, and I also send you a box of cigars which I beg you to accept as a X-mas gift. Let me know when you want more. Even if you do not smoke all of them yourself they come quite handy occasionally to make friends.

I have procured some large fruit jars and am now ready to breed insects from any twigs or roots etc. you may send on. In fact I would like very much to have you send on such things. I am well aware that this will cause you considerable trouble and expense but a good many insects can be obtained thereby which cannot be found otherwise, and as to the expense I will share it with you.

You seem to have trouble in getting your mail but you must remember that in a small place letters and packages are not delivered. During my stay in San Diego, Tex. I had to walk every day down to the post office, a distance of nearly half a mile.

Now to your letter of the 24th! I read it several times with intense interest, then went to the office and read it to Dr. Merriam who got quite excited at your account of the rat nest and had your letter at once copied. He informs me that all the rats of the Southwest which construct large piles of debris over the nests belong to the genus *Neotoma*; that there are quite a number of species within the U. S.; that the species found in the plains at Tucson is *N. albigula* and that in the mountains near by there is another species. Further, that he never found the rats in their nests but that the structure of the latter as described by you has

never been properly described and that any further observations on this subject would be most welcome to him.

(I shall continue this letter this evening)

Yours ever,

E. A. SCHWARZ

Washington, D. C. Dec. 29/96

(Continuation)

Dear Hubbard,

When you were here I think I told you that while on the stage near Brownsville, Tex., I saw plenty of those large rat nests but since they did not occur near San Diego I was unable to investigate the nest. However while looking at these remarkable structures in the midst of the Opuntia thickets I realized two points. first, that the nests must contain some peculiar insect parasites and inquilines, and secondly, that the investigation of the nests without proper implements must be a matter of great difficulty on account of the cactus spines. The large blood-sucking Hemipter you found in the nests is probably only the common *Conorhinus sanguisuga* Lec. which is quite abundant in Arizona, though it is not impossible that it may be another species of the same genus. The occurrence of this bug in rats' nests is not yet recorded but Coquillett told me this morning that he found *C. sanguisuga* in the nests of the same or allied species of rat near Los Angeles. The other species you mention in connection with this rat will be no doubt of considerable interest including the flea. The Coleoptera I fail to recognize except the "elegant yellow Lebia with steel blue elytra" which must be *Lebia chloroptera* Chaudoir, although I never saw this species before; nor is it in our collection. Dr Merriam tells me that most specimens of the *Neotoma albigula* which he or his men had trapped proved to be badly infested with a bot-fly larva (Oestridae). This must be a new species but it will be quite difficult to get hold of the imago unless you find the puparium in the ground beneath the nest.

The occurrence of Gopherus agassizii near Tucson is very probable since it is recorded from Ft. Yuma. Merriam in his Death Valley Report says: "This tortoise is remarkable . . . for

its power of living in the arid deserts of the Lower Sonoran zone, far away from water.''

Regarding insects on *Cereus giganteus* I never heard of any living in or on the healthy plant but Dr. LeConte records plenty of species in or beneath ''decaying'' plants and most probably you will also find them if you come across a decayed Cereus. The larva of a Monilema is, however, sure to be found in the roots of the living plant. The ''cavity'' in Cereus which you mention has probably been made by a woodpecker who stored the Parkinsonia seeds in it. *Bruchus amicus* is recorded from seeds of Parkinsonia from Arizona and is a rather large species, very gray but with indistinct reddish disk of elytra.

The fragments of Tenebrionids, Lachnosternas, Hoplias (?), etc., indicate a fauna which probably will not make their appearance before next April.

The small bristly Curculionid from *Phoradondron californica* is apparently the same *Tychius* which you sent (one specimen) among your lot 1 and to which I referred in one of my letters. I doubt that this species has any thing to do with the Phoradendron and suppose that it will live in the twigs of the ''claw Acacia'' (what species is this?) or in those of Mesquite. I most seriously doubt that your ''most minute shining black Coccinellid'' from the same plant is really a Coccinellid; it will be a Nitidulid of the genus Cybocephalus which have the power of rolling themselves into a ball like Agathidium. In southwestern Texas I found such a little Cybocephalus on Phorandendron feeding on a scale insect and the same species occurred on *Opuntia leptocaulis.* Mr. Knoebele found in California a very peculiar genus of Psyllidae on Phoradendron, and this is the only insect recorded from this plant.

The ''black Bruchus with red spots on elytra'' in acacia seeds remains for the present undetermined; do not fail to give me the scientific name of the Acacia. I forgot to mention above that *Bruchus ulkei* has been bred in Arizona from seeds of Parkinsonia. This is a tolerably large species, gray with a large black dot on elytra; it is the rarest in our fauna and wanting in our collection.

Regarding the rats' nest insects I would like to draw your attention to the ''swarms of small Lepidoptera'' because these may

prove to be a great interest and I hope that you did collect some good specimens. The Japyx, also, must be something good and probably a new species.

The large Hydroporus black with white mottlings is apparently one of the *Laccophilus* peculiar to Arizona. One of these species collected by Morrison is in our collection but the other is wanting.

Now this is about all that I can say of your insects without seeing the specimens and I can only assure you that I look forward to the receipt of your boxes with no small expectation.

I repeat what I have said in one of my earlier letters: do not overexert yourself in the pursuit of entomological explorations but always consider that you have undertaken this trip for the sake of your health. Do not dig into any of the so-called gopher holes without hiring a Mexican or someone else and do not continue the raking up of the rats' nests if the work is too laborious.

All the boys in the Office, including Dr. Merriam and Prof. Fernow, send their best regards and wishes to you; the same with Mr. Havenstein and Mrs. Kuhlmann.

News in entomology are very scarce; in our Office Mr. Nathan Banks has again been appointed as an assistant after a civil service examination. He is to do bibliographical work to continue Henshaw's bibliography of Economic Entomology.

I enclose some letters to Arizona parties written by Fernow for the purpose of introducing you. You will not need them, however, until the coming spring. If you are desirous of seeing the Papago Indians, Fernow says, you should by all means run out to the reservation and call upon Mr. Berger, the Sub-agent of the reservation and who is said to be a good fellow.

Yours ever,
E. A. SCHWARZ

Washington, D. C. Dec. 31/96

Dear Hubbard,

Nothing could give me more pleasure and furnish more excitement than the perusal of your letter of the 26th; 1st, because of the very gratifying account of the state of your health, and I feel confident that the improvement will be a permanent one; 2nd, on account of the exciting account of your exploration of that good

old Cereus trunk. I am afraid the name of the benefactor who cut the hole with his axe will forever remain unknown. In my last letter I wrote you about the fauna of ''decayed trunks of Cereus'' so frequently mentioned by LeConte but I could not know that you would strike so soon a favorable trunk in the right condition. Of course I shall report on your rats' nest and Cereus fauna as fully as I can as soon as I receive them but whatever they may turn out to be, it is evident that your letters deserve to be published as soon as the necessary determination of the insects can be made. I shall write you about the subject of publication later on.

Some of the Cereus insects I recognize with more or less certainty because their habits have been mentioned by either LeConte or Horn or Casey who have visited Arizona; but there are many others which I fail to recognize because no such thorough investigations as yours have ever been made.

''Philontid with large head, black with red elytra, etc.''—This is pretty certainly *Belonuchus Xanthomelas* Solsky, of which Dr. Horn gave me a few poorly preserved specimens.

''Monstrous Aleocharid, etc.''—This is unquestionably *Maseochara semivelutina* Solsky, new to our collection. Three other closely allied though smaller species are reported from the Southwest and northern Mexico of which you will find no doubt *M.* (*Aleochara*) *valida* Lec. which is entirely black. The latter species may be among your ''smaller unicolored Aleocharinae.''

The ''Stilicopsis or allied genus'' remains unidentified. Dtto. the large ''fly larva.''

The ''immense Hololepta'' is pretty safely *Hololepta yucateca* Marseul (*princeps* Lec.) the males of which are sometimes of prodigious size. Casey has made several attempts to break up this species into several ones. In our collection there are ♀♀ and a feebly develcped ♂.

''Large Scyphophorus or Sphenophorus larvae.''—These are safely those of *Cactophagus validus* Lec. of which we have in our collection 3 specimens from Morrison's collecting.

''Phalacridae both large and small and Histeridae of two species.''—I cannot tell anything about them at present except that *Paromalus* (Histeridae) *opuntiae* Lec. is probably one of your species. We have some specimens from Morrison's collecting.

"Black Tachyporus as large as an average Tachinus" is unquestionably *Physetoporus grossulus* Lec. described by LeConte from "Arizona; in trunk of *Cereus gigantus.*" Your "other species like a small Conosoma" may be *Erchomus punctipennis* Lec.

The various Curculionidae mentioned by you remain utterly unknown to me but it is safe to say that they will be among the most interesting Cereus insects.

"Ditoma which looks like ours."—This is pretty safely *Ditoma ornata* Lec. of which we have several specimens from the Morrison collection.

"Small Uloma and flat Tenebrionid near Cynaeus."—Remain unknown to me, and the same is your Bruchus, the "minute Staphylinid, perhaps an Euplectus," "several Bryaxis like Pselaphids." Of Pselaphids from Arizona we have in our collection only a single species, *Ctenistes pulvercus* Lec.

"Small Hololepta."—This must be *H. cacti* Lec. which is not in our collection.

I agree with you that it is strange that you fail to find any Nitidulids in the Cereus but these may hibernate elsewhere in the imago state.

It has been terribly cold here for the past 8 or 10 days; there is skating on the Potomac. You never tell anything how the climate of Tucson strikes you.

Yours ever,
E. A. SCHWARZ

Washington, D. C. Dec. 31/96

Dear Hubbard,

After further study of your Cereus letter it occurs to me that your "Phalacridae both large and small" will probably turn out to be Hydrophilidae allied to Cyclonotum (the larger) and Cercyon (the smaller ones). Some of these genera live in decomposing plant matter, and *Cyclonotum cacti,* a comparatively large species has been described by LeConte from "putrid Opuntias." The species is now referred to *Dactylosternum* of which you found on Montserrat another species, *D. abdominale,* under "ciba bark."

You also mention Scydmaemidae, and I would only say that we have only a single species of this family from Arizona in our collection, *viz., Eumicrus tarsalis* Casey, which is a rather large-sized species and has been collected by Morrison.

It is a pity that the Coleoptera collected by Dr. LeConte have been described in all sorts of publications running through many years. It is only in the oldest of this series of papers (published in Ann. Lyceum Nat. Hist. N. Y. 1851–2) entitled: "Descriptions of new species of Coleoptera, from California" that he refers to his expedition which was undertaken "during the year 1850 and part of 1851." At that time there was no such thing as Arizona but everything was California. He says: "My collection was made in the following manner: At San Francisco (here follows various localities in California), etc. . . . at Vallecitas (in southern California) and the desert of the Colorado, in October and November; Colorado River, December and March; Valley of the Gila, in January and February." At that time there was no Ft. Yuma and probably also no city of Tucson but LeConte must have crossed the Colorado River some distance south of Yuma at the old stage route; what precise locality he means with "valley of the Gila" I do not know but he means no doubt the lower part of the valley from Ghila Bend westward. Numerous new species of Tenebrionidae, Dytiscidae, Carabidae, Authicidae, Histeridae and Meloidae are described by LeConte in that paper which shows that the winter fauna of that region must be quite rich in species, and it appears to me that Tucson is, entomologically, not favorably situated. You will no doubt later on visit the lower Ghila and the Colorado River where you will experience less trouble than now in hunting up the fauna.

Yours ever,
E. A. SCHWARZ

Washington, D. C., Jan. 3, 1897

Dear Hubbard,

There was great excitement with me when upon my return from office I found yesterday your letter of Dec. 28th containing again a lot of interesting news; but the package was not there! Mrs. Kuhlmann, however, informed me that the letter carrier had

the registered package; so I rushed at once to the post office and fortunately got it. This enabled me to get at the contents at once but after working like a whole family of beavers yesterday night and this whole Sunday I have become painfully aware of the fact that you have completely swamped and overpowered me with "embarras de richesses" as Prof. Riley used to say. My, it will take me a whole week to mount this immense material and a whole month to get it named! In fact I did not know where to commence, but I opened at least every box and spread out the contents to see whether everything was in good shape. Good that I did so for in the box containing Opuntia species that *Acalles turbidus* had come to life again but fortunately without doing much damage. Look out for those hard Curculionidae and kill them with dry heat.

I have at last mounted the Rats' nest material and even did a little determining. The species are as follows:

1. "Large blood-sucking Hemipter."
   I should think this does not differ from *Conorhinus sanguisuga* Lec.
2. "Very small blood-sucking Hemipter."
   Very remarkable thing, evidently allied to the common Bed bug, but I cannot name it. Do not remember having seen it before. Shall try and have it named.
3. The rat-flea.
   Have not found it so far among your material.
4. "Lebiid, yellow, with steel blue eyltra."
   This is *Lebia majuscula* Chaudoir (not *L. chloroptera* as surmised by me), a species known from Arizona and Sonora. We had only two specimens in the collection. It is closely allied to our common *L. grandis* and I wonder whether your very slender larva really belongs to it.
5. "Lebia resembling a *Calathus,* castaneous and unicolored."
   This is *Plochionus pallens* Fabr., widely distributed in the tropics but new to our collection.
6. The Silvanus from rats' dung is *S. opaculus* Lec. described by LeConte from "the Colorado River under bark" (probably from Ft. Yuma), a very rare species and new to our collection.

7. The Cryptophagus from rats' dung is apparently undescribed and, while not a remarkable species, it is easily recognizable by its dense punctuation. Also new to our collection.
8. "Reddish oval Tenebrionid, size of *Dioedus punctatus* but in form like a Platydema."
   This is really a Platydema which I never saw before. Nor can I find that it has been described. New to our collection.
9. "Other Tenebrionids."
   One specimen of *Triorophus laevis* Lec. (black, legs reddish, head with a large tubercle).
10. "Other Tenebrionids."
   One specimen of Eurymetopon emarginatum Casey (slightly smaller than the preceding and of regular oblong-oval outline). This and no. 9 we have from Morrison's collecting.
11. "Other Tenebrionids."
   One specimene of a remarkable ? Blapstinus which I never saw before and which is new to us.
12. "Anthribide."
   This is a new Brachytarsus which I never saw before; allied to *B. variegatus*. New to our collection.
13. "Scaphidiid."
   This is a Scaphisoma, not at all remarkable but which upon close comparison may prove to be different from our eastern species.
14. "Small Histerid."
   Does not appear to differ from *Paromalus opuntiae* which is so common among your Cereus insects.
15. "Large Asida with bright blue pruina."
   Is *Centrioptera verrucosa* Lec., but the pruina is gone. We have this from Morrison's collecting.

The Myriapods and the Japyx (which should be something good) and finally the Lepidopteron have apparently not been sent by you. I sincerely hope that you preserved some of the Lepidopter since it is unquestionably something of great interest.

The above are all the rat insects mentioned or sent by you. It strikes (me) that, except Nos. 1, 2, 3, possibly 7 and the Lepi-

dopter, none have a direct connection with the rat. Should it not be possible to find something like Leptinus in the nests?

Your success with the Cereus insects is really astonishing and the enormous number of specimens you send prevents me at present from giving a list of the species. As far as I can see all insects ever reported from *Cereus giganteus* are represented in your collection and various new ones besides. I only miss one, viz., *Xanthopygus cacti* Horn, discovered by Dr. Horn at Camp Grant, Ariz., on "decomposing Cereus." It is a genus near Staphylinus and the species is black with bluish-black elytra and yellow tail; size of an average Staphylinus.

How many of your species are peculiar to this plant I cannot tell at present but when I have worked up your material I shall write you more on this subject.

[Here follows a preliminary list of the species found by Hubbard. See Psyche, Vol. 8, 1899, Supplement, for Hubbard's "*Insect Fauna of the Giant Cactus of Arizona.*"]

This letter is by no means finished but for the present I will close up and go to bed.

E. A. SCHWARZ

Washington, D. C. Jan. 4, 1897

Dear Hubbard,

I have shown your letter of Dec. 28 to Dr. Merriam who read with great interest your account of the fauna of *Cereus giganteus*. He says you are no doubt right in your conclusions but the holes in the trunks are not made by the owl but by the woodpeckers for storing seeds. The owl only uses the hole for sleeping quarters. There is a ridiculous superstition that the woodpeckers make the holes for the purpose of obtaining water during the dry season. Dr. Merriam says that these holes are extremely frequent throughout the entire Cereus region, and this explains perhaps why LeConte, Horn and Casey never experienced any difficulty in finding "decomposing Cereus." By the way, Dr. Horn's headquarters in Arizona was Camp Grant, on the San Pedro River, and this must be a most favorable locality.

There were among your lot II two envelopes—one containing mesquite pods from the rat's nest, the other galls on cat-claw acacia and seeds of Echinocactus—but they are not referred to in your letter. I put the mesquite pods in a jar to breed whatever may be in the beans, and the same with the acacia galls though most of them look very old. What shall I do with the cactus seeds? Parasites still continue to come out from the Mantis egg mass, and when mounted I shall turn them over to Mr. Ashmead.

Toumey's Chilocorus is Ch. cacti, the larva of which has been observed by Comstock to feed on scale insects on Oleander in southern Cala., and it is not surprising, therefore, that it should feed on the *Parlatoria victrix* on date palms at Phoenix. The imagos have frequently been found feeding on various scales but it cannot be denied that the species prefers to feed on Cactus scales. The tree cricket injurious to tobacco will be determined as soon as it can be mounted.

Four microscopic slide boxes are to-day mailed to you under Department frank, and I also return that you sent to me.

As to the Hemiptera I confess that I prefer to mount them myself and I shall turn over to Heidemann a good set but I could propose that you keep the first set for subsequent transmission to the Nat. Museum.

I inclose the revised list of the Coleoptera of your lot 1. You will see that I succeeded in generically locating that new Scolytid, and that I also named that large Otiorhynchid, *Eupagoderes decipiens,* to which you refer in your last letter. Well preserved specimens of these desert weevils (you will no doubt find various species) are most welcome, for those in the collections are mostly old alcoholic specimens which have lost all their beauty. The Hyperaspis you sent I concluded to consider as an extreme variety of *H. fimbriolata* which is not yet described.

It will take considerable time before I can furnish a similar list of your lot No. 2 and meanwhile you must be satisfied with the preliminary determinations of my last letter.

Two letters evidently inclosing checks from Railroad Co.'s have recently arrived and were forwarded by me to Mrs. Hubbard at Detroit.

Yours ever,

E. A. SCHWARZ

Washington, D. C., Jan. 5/97

Dear Hubbard,

I have just received a letter from Mr. Wenzel, of Philadelphia, with the news that Horn was stricken with paralysis at the Columbia Club during a game of cards (exact date not given). His left side is paralysed but his physician has hopes of bringing him around. For some time I was afraid that something of this kind would happen to Dr. Horn and I can only hope that he may recover.

Yesterday evening, instead of going to the Cosmos Club I remained at home and mounted two layers of your Cereus insects. Then I carefully looked at the mounted specimens and the results are the following changes and additions to my preliminary list:

Change *Belonuchus xanthomelas* to *B. ephippiatus* Say. New to our collection. Say described it from Mexico and LeConte (in the edition of Say's writings) adds: "I found it at San Diego, Cala., under dead Opuntia leaves.

After *Paromalus opuntiae* omit P. sp. and insert:

Paromalus consors Lec. Originally described by LeConte from specimens "found at San Diego, Cala., in decaying opuntias" in company with *P. opuntiae.*

Paromalus gilensis Lec. Originally found by LeConte "ad flumen Gila in *Cereis giganteis putridis.*" This adds another species to the astonishing large number of species new to our collection.

The three species of Paromalus found by you in Cereus are readily distinguished by the difference in the elytral striation.

You will notice that there are quite a number of Cereus insects of which, in addition to several new ones, you seem to have found all except two, viz., Xanthopygus cacti and *Erchomus inflatus* Horn. The latter greatly resembles the *Physetoporus grossulus* and may be still among your unmounted material. The Cereus fauna may be divided into three groups: (1) Species peculiar to *Cereus giganteus*; (2) Species peculiar to cactus plants in general; (3) Species of more general habit, for instance, such as occur also under moist bark of trees. There is very little known on this subject but I think you will have opportunity to ascertain to which division your species belong.

The parasite on Mantis eggs has been determined by Ashmead as *Podagrion mantis* Ash., which infests Mantis eggs throughout North America. The other parasite on a hymenopterous cocoon on Prosopis is an undescribed Eupelmus.

I was greatly mistaken when I wrote you that I could mount your lot 2 within one week; it will take me more than two weeks.

I sincerely hope that you are doing well. Write me how you find the climate, and whether you are satisfied with your quarters and with the meals. Do you get much information from Toumey? Did you make the acquaintance of Dr. Rogers?

Yours ever,

E. A. SCHWARZ

Washington, D. C., Jan. 10, '97

Dear Hubbard,

I wrote you before that you have utterly overwhelmed me with the multitude of specimens of your lot 2 but with the arrival of your lot 3 this misfortune has increased to a calamity. I do not know how and when I shall catch up in mounting or determining. During the past week I had not a minute to spare for your specimens: I had to straighten up my books as treasurer of the Entom. Soc. of Wash.; on Thursday there was a meeting of the Society in my house and, worst of all, since Wednesday Mr. J. B. Smith, Mr. Hopkins and Mr. Alwood have made their appearance, each with a big box of specimens for determination. They made my rooms as their headquarters and left yesterday night.

To-day (Sunday) I have been busy the whole day with mounting your Cereus specimens of lot 2 but made little impression upon the immense number of specimens still to be mounted. I had not even time to do a little determining and, for the present, you must be satisfied, to my regret, with an acknowledgment of the receipt of your lot 3 (registered package; box with Monilema, two packages cf Cereus pulp) and with a short account of "Cioid" from Giant Cactus. Your letter of Jan. 3 arrived here on Friday (Jan. 8) and I read it repeatedly with intense interest and greatly wondered that the Cereus fauna did not seem to have any end. I must confess that your account of the "most marvellous Cioid" did not strike me particularly and made up my mind

that it was a species of *Ozognathus* (Ptinidae), the males of which have peculiarly-formed horns on the head. On Saturday upon returning from Office after 4 O'cl. P. M. I found your package and in order to see whether everything was all right I opened the pill boxes. When I came to the box containing the "Cioid" and looked at the latter I came near being paralyzed and it required a superhuman effort and a swallow of whiskey to recover. Your Cioid turns out to be a most remarkable and entirely new genus of Scolytids!! In fact it is a long time since I put my eyes upon a more odd-looking creature than this species. After recovery I mounted at once a couple of specimens, for it happened that at 5.35 P. M. I had invited Smith, Hopkins and Alwood to dinner at Gerstenberg's with the understanding that they should spend the evening hours in my room, all three of them to leave between 9 and 10 o'cl. with the B. & O. R. R. During dinner (everything as usual fried in cockroach grease) I narrated about that Scolytid and Hopkins could hardly wait for the time to look at it. Upon returning home the specimens were at once exhibited and Hopkins became perfectly wild with excitement and cursed his miserable West Virginia Scolytids because they did not show any distinguishing characters except after a most painful scrutiny. One of your Scolytids ♂ happened to be alive and we had an opportunity to watch the movements of this wonderful species. Smith got also excited and in order to prevent further mischief I had Ida at once fetch a pitcher of lager beer. This smoothened the excitement and two subsequent pitchers were drunk to your health, and it was unanimously voted that no one but yourself would have been able to unravel the secrets of the Cereus fauna.

The affinities of the Scolytid are at present entirely obscure to me and I do not know whether it belongs to the Tomicinae or Hylesininae. Of course I had to give Hopkins a few specimens and he promised to make dissections of the mouth-parts and genitalia.

During this week I hope to have more time and shall try my best to mount and determine your lots 2 and 3.

Yours ever,

E. A. SCHWARZ

P. S. Not only one of Scolytids but also several of the Cereus Calandrids were alive in your boxes. Your Cyanid does not seem to work well or you take the specimens too soon out of the collecting vial. No serious damage has been done but I beg you to be careful in this respect.

E. A. S.

Washington, D. C., Jan. 11/97

Dear Hubbard,

As I wrote you yesterday, it will take considerable time before I can get at your lot 3. In fact I have only looked at a small proportion of the specimens and for this reason I can reply to your letter of Jan. 3 only in a fragmentary manner. The following remarks refer mostly to Cereus insects mentioned by you:

The "large Calandrid, not shining, elytra black, without sculpture" is unquestionably *Cactophagus validus* Lec. The allied genus, *Metamasius sericeus* Latr. (smaller than Cactophagus, opaque, black variegated with red) is also reported from Arizona but nothing is recorded of its habits. From its general appearance it belongs either to the Cactus fauna or the Yucca fauna. We have a good series of *C. validus* in our collection (Morrison) and you will no doubt find it plentifully later in the season.

Among the small delicate Cereus things I glanced only at the "small shining, almost spherical things, perhaps a Liodes" and had the impression that it is a new species of *Ephistemus* (Cryptophagidae) which I have not seen before.

Extremely glad to see the brilliant Staphylinid, *Xanthopygus cacti* among lot 3. It is a genus new to our collection. You write that you sent it also with lot 2 but strangely enough I have not yet come across the specimens.

Of the marvellous Scolytid I wrote you yesterday and will merely add that this morning I looked at a few specimens and came to the conclusion that two species are represented among them, one in which the horns of the ♂ are long, straight, porrect or vertical; the other in which the horns are shorter and recurved over the thorax. There are also differences in the elytral sculpture.

The "small Anthonomus-like Curculionid with rough sculpture" I have unfortunately not yet seen, but is no doubt something of unusual interest.

There are so many Cleridae reported from Arizona that it is impossible to tell to what genus your "small hairy larva" belongs.

The large silvery-grey Bruchus is *B. amicus* reported before from Parkinsonia seeds. One of your large pale-brown Bruchus with black spots is the common Mesquite species, *B. prosopis,* but there are evidently other species among your material which I cannot name offhand. The Palo verde in southwestern Texas was not infested by insects (except the *Bruchus amicus*) but I think the shrub is not native there and has only run wild from gardens. In early summer the flowers attracted Malachiids and Diabroticas. As I wrote you before, a great many of the Cereus insects are reported also from other Cacti and Coquillett found many of them near Los Angeles in *Opuntia engelmanni.* The *Hyporhagus* from *O. engelmanni* is not yet determined; the Acalles from the same plant is *A. tubidus* which I found commonly at San Diego, Tex. On *O. leptocaulis* you will no doubt find later in the season another, smaller Acalles and also the larva and imago of a blue- and red Disonycha (*D. varicornis*), and also a black, opaque Baris, all of which I found in southwestern Texas.

Coquillett has published a note in Insect Life stating that *Maseochara valida* (one of the giant Aleocharinae in Cereus and Cactus) is truly parasitic in the puparium of the Cactus flies. I never can believe this and maintain that the Maseochara larva is merely predaceous and enters the fly-puparium to devour the contents. Perhaps you will be able later in the season to throw some light on this point.

Your most interesting letter of the 4th came this morning. I am quite astonished to learn that the weather is so cold with you; I always thought that there was never any frost at Tucson. It seems from your account that the winter fauna of Tucson is after all not so poor as you complained of at the beginning and that besides the bonanzas in the rat's nest and *Cereus giganteus* you bring together a respectable collection. Of the larger Teneshall report on it in my letter to be mailed to you at San Diego.

brionidae, any Arizona specimens, even the most common species, are very acceptable to our collection, and later on when you visit localities you must not forget to take specimens at each locality. The great confusion that exists in Coniontis, Eusattus, Asida, Eleodes, etc., as to what should be considered as a species results mainly from the carelessness with which specimens have hitherto been collected and labeled.

As a matter of course we will name and return Mr. Brown's insects or anything he or you may send on of his collection. The *large* Strategus is no doubt *S. julianus* (a ♂ is desired for our collection); the *smaller* must be *S. cessus* (an extremely rare species not in our collection) or a new one. If Mr. Brown's Solpugo (large Arachnid looking like the Idaho devil, *Stenopelmatus*) is a large one, it is *S.* (Datames) *formidabilis* Simon; if it is a small one it can not be named without seeing the specimen. If the large "Alindria" is of blue color it is *Trogosita* (*Temnochila*) *virescens* which occurs everywhere. The Clytid from Mesquite wood piles is *Cyllene crinicornis,* extremely abundant in southwestern Texas. Under the same conditions you will find later in the season various Chrysobothris and other Buprestidae—The small, not hairy Cotalpa is probably *C. flavida* Horn. The small Lachnosterna is probably *Listrochelus.* The "*Coccinella* 15 *punctata*" may be our common *C. oculata.*

I do not believe that any adobe wall will contain Anthrophora colonies, and I mentioned this subject to you only in order that you may be on the lookout for them. Should you find a Meloid in them it will probably differ from *Hornia minutipennis.*

Your account of the Sta. Cruz River canons reminds me of the San Diego River at San Diego, Tex., but the latter has vertical cliffs of solid lime stone and there was not a drop of water in it during the whole of my stay; the small side canons had also rock walls but swarmed with Eleodes which had fallen in from above.

Even if the burrows of *Gopherus agassizii* should furnish no insect fauna, its dung will no doubt be frequented by the various species of Aphodius, etc., peculiar to Arizona.

I am afraid you will be disappointed with your winter visit to the great Mesquite forest. In April or thereabout when the trees

will be in bloom they will no doubt swarm with a multitude of Cerambycidae, Cleridae, Chrysomelidae, Meloidae, etc., but I do not know whether there will be any insect life in winter. If the forest is composed of real trees (not mere shrubs as is the case with the Mesquite "forest" of southwestern Texas which is at least 4 times larger than that of Arizona) you may find various good things. At any rate I am greatly curious to learn of your experience.

The specimens you sent to the Department have safely arrived. Pergande showed me Comstock's types of *Tachardia Carreae* and this is *evidently* quite different from your species though both, with a third species, occur near Tucson. The tin boxes you sent are herewith returned to you and I also will at once return the wooden box. From the Division of Mammalogy I learn that a species of Wood rats (*Neotoma*) occurs here at Washington among the rocks along the Potomac near Great Falls but this species never builds a pile.

The whole of last Saturday and to-day (Monday) I was occupied in the office with straightening out the galley proof of your full article on Ambrosia beetles but it proved to be a big job since the Editing Division has made a complete mess of the text and a still more complete confusion with the figures. There was some tall swearing on my part but the work is nearly done. By some queer coincidence I have just now come across a figure of the ambrosia of *Xyleborus dispar* published by R. Goethe in 1895 in a German publication extremely difficult to find and the title of which would fill 3 lines. His text is only a short note, with the figure, is only one page long. He does not give any description or determination of the ambrosia but merely states that he saw it being eaten by beetles. The character of his drawing is, however, exactly the same as that of your drawings. If I had discovered this figure sooner we would have made a copy of it for insertion in your paper, but so it was too late and I added only a short reference to Goethe's publication.

I most sincerely hope that this letter will reach you in good health.

Yours ever,

E. A. SCHWARZ

Washington, D. C., Jan. 18/97

Dear Hubbard,

I have received your card of the 10th and your letter of the 11th, and this (Monday) morning four packages arrived, two containing Neotoma nests, the third that Polyporus fungus and the fourth that most surprising find of yours in the woodpeckers hole in Cereus. Your card informs me of your intended trip to San Diego undertaken I suppose to have your round trip ticket stamped, but you do not say whether and when you will return to Tucson.

Since you write that you are not certain whether you will stop at Yuma I write only a few lines but let you know that I shall write fully in answer to your letter of the 10th and that you will find my letter at San Diego on January 25th.

If you stay over at Yuma I am afraid you will be disappointed with the insect fauna there at this season but a large number of species are reported from that region. In 1850–51 Dr. LeConte was in that region, and in looking over his descriptions I find that almost all of his species were either found at the banks of the river or "under bark of Cottonwood trees." Many of these species are not in our collection, e.g., the various Anthicids and a small flattened Staphylinid, *Eleusis fasciata* (Omaliid group) from Cottonwood bark; but I am afraid all these fine things will not be about during this unusually cold spell you have in Arizona. In California you will see so many new features that I suppose you will have no time for entomological researches. The beach fauna of San Diego is very rich in species and has been well explored but at this season the insects will probably be absent. A little railroad goes from San Diego to National City and thence across the Mexican frontier a short distance into Lower California and then you have a chance of visiting the latter country.

Since I wrote you my last letter I have been hard at work every evening and the whole of yesterday (Sunday) mounting your lot 2 and I have fortunately finished the lot excepting one layer of small Cereus Aleocharinae. I have also mounted the contents of the second tin box (the first contained things given you by Brown or Toumey) which I have marked "lot 3 A" and shall report on it in my letter to be mailed to you at San Diego.

The Polyporus came to hand and I see the Lepidopterous larvae, which will not be difficult to breed, but unfortunately not the little spotted Melandryid. I cannot even guess what this species may be but I presume it will be something new. At least a portion of the Tenebrionid larva from Neotoma nests are apparently in good condition and I hope to breed the species. The larvae is certainly not an Eleodes and may belong to Nyctobates.

I sincerely hope that you have recovered from the accident to your eye; the beating of the mesquite branches into the carriage is a danger with which I became thoroughly acquainted during my stay in southwestern Texas. I also hope that these lines may find you in good health in spite of the cold weather and that you may enjoy your California expedition.

Yours ever,

E. A. SCHWARZ

Washington, D. C., Jan. 20, 1897

Dear Hubbard,

I wrote you yesterday a short letter to Yuma but it contained very little information and it would, therefore, be no misfortune if it should not reach you.

This morning I received your letter of the 15th and 3 packages (2 with Toumey's pinned specimens, and one with miscellaneous material not yet investigated by me).

I hope your health will not suffer under the influence of this miserable cold weather you have at Tucson. I am watching the daily weather maps and feel extremely sorry for you when day after day a rain area is marked over southern Arizona. Better times are sure to come, however, and perhaps the spring collecting will be better on account of the unusual amount of winter rain.

From your letter of the 11th I am greatly pleased to hear that my reports on your insects are satisfactory to you but I can only assure you that I derive a still greater pleasure from the perusal and study of your letters so full of life. Your short but characteristic descriptions of insects together with that card catalogue which I have constantly on hand enable me to recognize in many

instances your species but of course there are numerous mistakes which can be corrected only upon a study of the insect itself. Among the Washington entomologists there is unfortunately not one who is able to appreciate your letters but friend J. B. Smith who read them got quite excited with interest. Upon your return we must by all means arrange a publication of these letters.

Your account of the Sta. Rita Mts. expedition opens a new vista upon the hitherto unexplored insect fauna peculiar to the Yuccas, Agaves, Dasylirions (I never saw this plant) and the other plants you mention. Of Yucca insects a number of them are on record, besides the Yucca Lepidoptera; as to Coleoptera, neither LeConte or Dr. Horn seem to have investigated this fauna, and Crotch was the first to find some of the species peculiar to the plant, including the genus Yuccaborus and the remarkable *Trogosita yuccae* (not in our collection). But this was in the Mohave Desert of Cala.

Of Dasylirion insects very little is on record; in fact I know only a short note by Townsend (Insect Life 5, p. 38). He mentions only two Coleoptera, the beautiful Buprestid *Thrincopyge alacris*—"almost every last year's Dasylirion stalk is bored and tunnelled throughout its length by this Buprestid." (This is in Solidad canon, Organ Mts., of New Mex., and the plant is D. wheeleri.) The second species is "Rhizophagus sp." (certainly no *Rh.* but I cannot make out what it can be) of which he says: "the beetles were distinctly seen to be eating into the young paniculate flower buds which were at this date (May 23) just developing beneath large protecting scales on the main stalk. Under these scales the beetles were numerous, and not only the embryo flowers, but the stems which hold them, had been extensively eaten." The large Calandrid mentioned by you is no doubt a *Scyphophorus* (probably *acupunctatus*) though I am not aware that any species of this genus is reported from Dasylirion.

Of Agave insects there is also very little known; Crotch described the Nitidulid *Anthonaeus agavensis* from flowers of Agave at San Diego, Cala.; and Riley mentions (Proc. Ent. Soc. Wash. II) a few insects bred from old Agave flower-stems, two being Coleopterous, the Buprestid genus Thrincopyge and a small new Calandrid. Finally, Wickham records *Zygops niveus* (me-

dium sized, black & white Curculionid allied to Copturus) common on the leaves of the Mescal plants in the Pinal Mts. north of Tucson and states that various Lebiid beetles are to be seen on this plant but that is quite difficult to get at this fauna.

The *Fourcroyeria* is a plant unknown to me and never mentioned in entomology; the same is with the *Microramnus*. Whether your Celtis will be as rich in insects as the Texan *C. texana* I do not know. The shrubby *Celtis pallida* in southwestern Texas did not harbor Coleoptera but a remarkable Psyllid, which rolls up the leaves. I am not aware that any entomolog. traveler in Arizona has ever referred to insects living on Celtis in that territory but Morrison sent from Ft. Grant a species of Pachypsylla which necessarily lives on Celtis.

Your Tenebrionid larvae from Neotoma nests I have given into the care of Pergande who will do his best to breed them but he says he had hitherto no luck whatever in breeding here Tenebrionid larva coming from the arid West.

Pergande also informs me that your "?? Sinoxylon larvae" given you by Mr. Brown from the Termes-eaten house post, are the larvae of an ant which had no doubt its nest in the old excavation made by the *Calotermes*.

In both of your last letters (Jan. 11th and 15th) you report on additional discoveries of the desert fauna in the vicinity of Tucson and I think I will find the specimens in the box which came this morning. This fauna as investigated by you is getting quite numerous in species and the same is to be said of your collections on Mesquite bushes. In your lots 2 and 3 there are various contributions to this Mesquite fauna, each containing the little Apion, *Tychius setosus* and the queer little Psyllids but each also containing one or more interesting little things not sent by you before, most of them being uniques. I shall report on this fauna in full at a later opportunity.

I have finished the mounting of your entire lot no 2 and 3 a and have commenced upon lot 3. For the most interesting part of this lot viz. the Cereus Scolytid and the pill box with subtile Cereus beetles I have to wait for a clear Sunday morning before I dare to mount these delicate and rare species; but I have mounted some of the Cereus-fauna duplicates. I see that among

your Cereus Hololepta you have 3 species; 1st the large *H. yucateca,* 2) the small *H. vicina,* Lec. (in my preliminary list incorrectly mentioned as *H. cacti*) and 3) the true *H. cacti,* one specimen of which was among the duplicates of *H. yucateca* collected Dec. 29 and 30th. It is much smaller than the largest specimens of *yucateca* but only a little smaller than the smallest yucateca. It has always one *entire* elytral stria, the propygidium is without smooth, shining median area, the mentum has on each side an undulating carina and the prosternal ridge projects anteriorly in a very acute point.

(I shall continue this letter this evening)

Yours ever

E. A. SCHWARZ

Washington, D. C., Jan. 20 '97

(Continuation of letter written this afternoon)

Dear Hubbard,

I have also not only mounted the many hundred Cereus Aleocharids of lot no. 2 but carefully looked at each and every specimen. The species found by me are as follows: 1) the giant species, *Maseochara semivelutina*; 2) next in size, *M. valida,* entirely black 3) Smaller species, *Maseochara* sp. with very opaque thorax and red elytra; 4) of the same size as No. 3, *Maseochara* sp. thorax opaque, elytra reddish with oblique dark stripe; perhaps not specifically different from No. 3; 5) the smallest species, *Atheta* (*Homalota*) n.sp.; not opaque, black above. base of antennae & legs pale; varies in size. All these are represented by large series of specimens but I succeded to my surprise in finding 2 specimens of a rather remarkable 6th species, apparently also a Maseochara, black with very short elytra which have a faint yellow apical spot. In size this species is slightly longer than No. 3 or 4 but much smaller than no. 2. I think it will be next to impossible to recognize this rare species while it runs about among the hundreds of the other more common Aleocharids.

Toumey's pinned Coleoptera have arrived in good condition. I shall gladly name and return everything (or at least a specimen of each species)—none of them are looking very inviting—as

soon as I learn of your return to Tucson. I shall also gladly prepare for him a set of your duplicates and what we can spare of Morrison's collecting. His "*Eurymetopon rufipes* Eschscholtz" has been found by you abundantly under Mesquite bark.

Whether or not the fauna of the Screw-bean, *Prosopis pubescens* (formerly Strombocarpus) differs from that of the common Mesquite, *P. juliflora* is not known but the Bruchid infesting the seeds are identical.

A box of cigars is herewith mailed to you and I hope you will get it safely at the general delivery window of the postoffice. This request is the only indication from which I infer that your health is in desirable condition for, otherwise, you would not write for cigars. I regret that in your letters you are so silent in regard to news of yourself; nor have you written me a word what news you have of your family.

I wrote you to Tucson on Jan. 10th and 11th (or 12th?), two letters, which you had not received when you wrote your letter of the 15th.

Heidemann is coming to me next Friday evening when we will have a conference anent the Arizona Hemiptera. Your collection from Heteroptera from desert plants contains a number of beautiful small species, some of them I have never seen but the best ones being represented by only one or two specimens each. The small bed-bug (Anthocorid) of the Neotoma cannot be named here in Washington and will be sent to Uhler. How many of the Cereus Hemiptera are really peculiar to this plant or to Cactaceous plants in general, it is impossible to say at present since no attention to the life habits of western Heteroptera has ever been given. However, observations during spring and summer will easily clear up these uncertainties.

This evening there will be an exciting meeting of the Joint Commission of the Scientific Societies of Washington held for the election of new officers. The Geologists and Chemists are at work against Mr. Gardiner Hubbard the present president of the Commission and president of the National Geograph. Society because he is not strictly a scientific man. He is, however, a very rich man, one of the regents of the Smithsonian Institution and if he should not be reelected there will be a great row.

P. S. I have just opened the pill box containing your collection of the past week. The "spotted Melandryid" from the Polyporus unfortunately proves to be a Mycetophagid, the widely distributed *Litargus balteatus,* but in compensation of this disappointment I notice in the box one specimen of the rare (and new to us) *Diaperis rufipes* Horn described from Camp Grant, Ariz. "under cottonwood bark." The two Otiorhynchidae are very good, the "Copturus like species" is Casey's genus *Elissa.* The "Cryptohyphus" is a *Horistonotus* which I do not see in our collection. Two specimens of a Dorytomus had come to life again (!!) and were walking about in the box. Look out for your cyanide!

Yours ever,

E. A. SCHWARZ

Washington, D. C., Jan. 21/97

Dear Hubbard,

Still another box containing the Lamellicorn larvae from Dasylirion arrived this morning. The larvae appear to be in good condition but it will hardly be possible to breed them here; for even if they are full-grown they will not pupate before several months. It is almost certain that they do not belong to Lachnosterna or Listrochelus but they may belong to the Dynastini and possibly to the genus Phileurus. If so their mode of living would be in conformity with that of the known species of this tribe though of course I can not explain how they got in the interior of the Dasylirion trunk.

To my great surprise your Dasylirion Calandrid turns out to be a Yuccaborus! which are recorded only from Yucca stems. In our collection we have only one specimen from New Mexico and several others belonging to an undescribed species from Brownsville, Tex. Since your specimens are in fragmentary condition I cannot tell whether they agree with *Y. frontalis* Lec. which was discovered by Crotch in Yucca stems in the Mohave Desert of California.

I do not know how long you intend to stay in California nor whether your ticket allows you to stop over at Los Angeles or some other points. Coquillett says you would enjoy greatly a

short stay at Palm Spring in the Desert where there is a good hotel and where you would have an opportunity of seeing the native palm trees of California, *Washingtonia filifera.* In the dead trunk of one of these trees the giant Bostrycid, *Dinapate wrightii,* has been discovered. Coquillett also gave me some addresses: In San Diego there is no Entomologist but Mr. C. R. Orcutt (he lives at Orcutt which is a suburb of San Diego) is a noted florist and seed dealer well acquainted with the wild plants of the desert. Coquillett says he is a crank but may possibly drive you out in the desert to show you the Washingtonias. At Los Angeles there is Dr. A. Davidson (119 1/2 South spring St.) a good entomologist who writes about the habits of bees, and is corresponding with Coquillett and Ashmead. He would certainly be glad to make your acquaintance and show you the best localities near Los Angeles. Dr. E. C. VanDyke of Los Angeles (Dr. Davidson could give you the address) is said to be a young Coleopterist and a nice man. Mr. John Scott, the County Horticultural Commissioner, room 11, Court House, Los Angeles is a well informed man in orange culture and insects of the orange; he has a splendid orange grove. There is further Mr. H. C. Fall, the Coleopterist of Pomona (not very far from Los Angeles) and finally your old friend Prof. A. J. Cook at Clairemont near Pomona.

Another letter evidently containing a check of the Western & Lackawanna R. R. Co. arrived for you this morning and has been forwarded by me to Mrs. Hubbard.

Dr. Merriam read with great interest your account of the mouse and rat's nest in Dasylirion and had it at once copied. This morning he came over to my office having the identical specimen of the Dasylirion mouse that has been killed by you and which has been sent to him by Mr. Brown. Its name is *Peromyscus eremicus.* Merriam also says that the Neotoma from Dasylirion is probably different from the plain inhabiting species.

Do not fail to let me know how long you expect to stay in California so that our correspondence should not become more disarranged than it is at present partly on account of the great distance and partly by the mismanagement of the Tucson post-office. I would also beg you to number your invoices, even the

smaller ones, so that they can be easily referred to in corresponding. I have numbered your last invoice which came yesterday and to which I referred shortly in my yesterday's letter, No. 4

Yours ever,

E. A. SCHWARZ

P. S. Two microscopic slide boxes are herewith returned to you under Dep't frank.

Washington, D. C. Jan. 22/97

Dear Hubbard,

There is no end of new species among your Cereus insects! In your lot 3 there is a pill box with "duplicates" containing many hundred specimens of the Cereus Hydrophilids Staphylinids and Histerids. One or several specimens must have come to life again and some damage has been done to the antennae and legs of the more delicate specimens. On account of the multitude of specimens and the breakage the box did not look very inviting but I resolved to tackle it right away in order to dispose of it. Although for three evenings I have been working hard at this box I have not yet mounted one half of the specimens but I have been rewarded by finding some very interesting things among the so-called duplicates. It was among the Hololeptus in this box that I found the only specimen of *H. cacti* of which I wrote you lately. Among the multitudes of *Physetoporus grossulus* I finally found a specimen of the missing *Erchomus inflatus,* and there may be more specimens in the box. It is somewhat smaller and stouter than the Physetoporus and of a dark reddish-brown, never black, color above. It is twice the size of *Erchomus punctipennis* with which it cannot be confounded. Then I found several specimens of that rare, rather small Maseochara I wrote you about recently and of which there were only two specimens in your lot 2. Finally, yesterday evening I made still another interesting discovery in the same box by finding another Hydrophillid, new to the Cereus fauna. It is a new species of the genus Megasternum, of the same size as the little *Pelosoma capillatum* so abundantly found by you but more brownish in color, less shining, the elytra with stronger and more impressed lines of punctures and with a broad and

elevated posternum. Whether in collecting this new species can be readily distinguished I do not know but I suppose it will be common in other localities.

These are several obscure points connected with this interesting Cereus fauna: 1st) is it really true that the holes in the Cereus trunks are really made by the woodpeckers for the sole purpose of storing seeds? Should it not be possible that these birds are looking for insect larvae boring in the hard rind? This brings up the second question: is a healthy *Cereus giganteus* ever attacked or bored into by insects or their larvae? Of course all these questions cannot be answered by winter observations but if you are still in the Cereus region late in the spring you can probably throw some light on these points. Mr. McGee, the ethnologist, who is, however, neither a botanist nor an entomologist, alludes in his ''Expedition to Seriland'' (which is in Sonora—along the Bay of California) in a mysterious way to the ''Cereus insect'' and its relation to the plant. I have copied a part of his account and inclose it herewith. It is impossible to find out what he can mean but perhaps Prof. Toumey is able to give you a little more information, on this point.

Yours ever,

E. A. SCHWARZ

Washington, Jan 25/97

Dear Hubbard,

I have your letter of the 17th from which I see that you got my letters of the 10th and 11th acknowledging the receipt of your lot 3. I wrote you also on the 12th or 13th and returned 2 boxes with specimens given you by Brown and Toumey. Since that time I wrote you one letter to Yuma and various others to San Diego but I am afraid it will take some time before you get all these letters together unless you have carefully instructed the postmasters regarding forwarding resp. retaining your mail. I also sent to San Diego some empty boxes and a box of cigars. I hope that the climate of the Pacific coast will not interfere with the improvement of your health and that you will enjoy the novel scenery. Do not fail to let me know in time how long you expect to stay in Cala.; and in case you have stopped over

at Yuma I am of course very curious to learn of your experience. Dr. Edw. Palmer has lately returned from Durango, Mex., and I enquired of him regarding the country at the mouth of the Colorado but he gave a most dismal account; there is nothing down there but shifting sand banks and a few salt marshes (with a very peculiar rice-like grass), the only remarkable thing being the tremendous surf at the bar.

On Friday (22nd) evening Mr. Heidemann came to me and looked over your Hemiptera. He admired greatly your small species from Mesquite and desert plants but was not particularly struck with the Heteroptera from Cereus excepting a rather small yellow Pentatomid near Euschistus. I gave him a good set of the duplicates and hope soon to be able to send your names. The small bed-bug parasitic on *Neotoma albigula* is certainly something of great interest; I made it out to be an Anthocorid and waded through the entire Monograph of Reuter's without finding it but Heidemann thinks it could be a winged Acanthiid. I have now sent a few specimens to Uhler. Some considerable doubt has also arisen regarding the determination of your Conorhinus larvae and pupae. It may turn out that all records of the occurrence of *C. sanguisuga* in Arizona are incorrect, and that the true *sanguisuga* has spread from Mexico into the U. S. by way of lower Texas and not by way of Sonora and Arizona. The South Californian species is an apparently undescribed species (unless described from the West coast of Mexico but there are no Arizona specimens (imagos) in our collections here, nor have we any larvae and pupae of the Californian species. Thus we cannot ascertain whether or not your species is identical with that from southern Cala. If you could connect the pupae from Neotoma nests with the imago by breeding or otherwise all doubt would be removed.

Yesterday I mounted a large lot of that Cereus Scolytid but am still greatly puzzled about this marvelous species. I see now that the difference in sculpture is due to a peculiar exudation or incrustation which fills up the punctures and obliterates the elytral sculpture but the differences in the form and position of the cephalic horns of the ♂ I fail to understand. If the material represents a single species it must be assumed that as long as

the beetle is immature the horns are curved and recurved over the thorax and that when it gets older the horns straighten and become erect or even porrect. Have any of your pupae the horns erect?

As to the mounting of your duplicates I would say that no matter how many of them it would not cost much time to mount them if they could be undoubted duplicates but referring you to my last letter you can see that interesting and even new species can be found in a box with so-called duplicates. At any rate since my last letter I have made good progress in mounting and I commence to recover my courage.

The whole of your lot 4 is now mounted. Of special interest are the *Araeoschizus* found under stones Jan 4 and 14th. There are not less than 3 species among them 1) *A. regularis*—each elytron with 4 ridges, interstices biseriately punctured, elytra without erect setae or erect scales—2) *A. n. sp.*—each elytron with 4 ridges, interstices biseriately punctured, elytral costae with *erect* setae—3) *A. costipennis*—each elytron with 7 ridges less elevated, interstices uniseriately punctured, elytral costae with recurved hairs.—This is an unexpected addition to our collection, since No. 3 is new to it and of Nos. 1 and 2 we had one specimen of each. Wickham found at Tucson (in June or July) still another species, *A. fimbriatus* which generally agrees with your *A. n. sp.* but has a *deep* longitudinal thoracic sulcus. A fifth Arizona species, *A. decipiens* collected by Morrison (precise locality unknown) is in our collection; it is closely allied to *A. costipennis* but much larger and without recurved hairs.

Your "Cryptohypnus" is *Horistonotus pullatus* described by Horn from Morrison's collecting. Various similarly colored Cryptohypnus-like Elaterids are likely to occur at Tucson or in the mountains near by. They are all rare in collections but no true Cryptohypnus of this size has been found in Arizona.

Of the two Otiorhynchids found under stones Jan. 9 and 14th, the smaller, shorter one (I suppose this you called "Neoptochus") is not in our collection and appears to be undescribed. It is really allied to Neoptochus. The second, larger, more elongate species of which you found a large number of specimens is *Elissa laticeps* Casey, described from El Paso, Tex. A second,

so-called species of the same genus was described by Casey from Yuma, Ariz.

Among the rather small, brownish black, elongate-oval Tenebrionids which you find so plentifully under Mesquite bark and scale of Cactus there are two species, both belonging to *Eurymetopon* (the genus may be recognized by the form of the anterior tibiae, the outer angle of which is prolonged), the larger one is correctly named in Toumey's collection *E. rufipes* Eschsch. described from San Diego. The second species is much smaller and more elongate and I have no name for it yet. Of the closely allied genus *Emmenastus,* which has the front tibiae simple you have hitherto sent two species (not yet determined) one among the Cereus things, collected Dec. 30th, and the other found in debris of cactus, Tucson Mts. Jan. 14''. The little Blapstinus (two specimens found Jan. 9th, one being dead and eaten by a spider) is not in our collection. Several species of this difficult genus will no doubt abound in specimens near Tucson in sandy places later in the season.

The ''Baris or Centrinus'' (one specimen found dead Jan. 9) is *Onychobaris mystica* of which I wrote you in one of my former letters as possibly occurring near Tucson on Opuntia leptocaulis. I succeeded in cleaning the specimen from the adhering spider's web.

The Yuccaborus from *Dasylirion* agrees with our specimen from New Mexico and is doubtless *D. frontalis.* The fragment of the large Cereus Calandrid belongs to *Cactophagus validus.* Two other Rhynchophorid fragments in one of the two match boxes belong to *Eupagodores decipiens* of which two good specimens were found by you before.

The Chlamys found on Jan. 7th is not the common *C. plicata* (though this occurs also commonly in Arizona but *Chl. memnonia* Lac. which is the type of the famous genus Diaspis Lac., the only genus in Coleoptera which has two scutella, i.e. the metanotum becomes visible behind the true scutellum between the elytra. Subsequent observations have proven that this character is not a constant one and the genus has been abandoned for many years but it is revived by Jacoby in the Biologia Centrali-Americana. *C. memnonia* does not seem to be rare in southern Arizona for it was abundantly found by Morrison.

The *Cereus giganteus* insects sent along with your lot 4 and collected on Jan. 14th did not contain anything new. Among the *Physetoporus grossulus* there was no *Erchomus inflatus,* but of course the beautiful *Xanthopygus cacti* is still most acceptable. However, the Termite from Giant Cactus (Your No. 14) is a really wonderful species, mainly on account of the antennae of the soldier which are only 9-jointed and have the 3rd joint enormously elongated and clavate. I think that the pale, blind specimens represent workers and thus the species can not belong to Calotermes but must belong to Termopsis or a new genus. Winged specimens are greatly desired.

The flea and the mite of the *Dasylirion* mouse nest I have turned over to the Department for determination; the flea will be sent to Mr. C. F. Baker who has made a specialty of the study of fleas and Mr. Banks will try and name the mite.

The beautiful *Diaperis rufipes* (new to our collection) found by you Jan. 10 is unfortunately minus legs and antennae, no doubt long since dead when found. I hope you will find living specimens in the spring. The two ''Anthonomus'' in dry fungus on Cottonwood, same date, belong to an unnamed species of Dorytomus which you will find commonly on Cottonwood trees or calkins in the spring. They were alive when the box arrived but there was something else alive in the box which alarmed me and which you did not collect knowingly, viz. 5 specimens of Silvanus *surinamensis.* Where they did come from I do not know, but presumably from the body of the Asida, placed by you in the match box and which was evidently dead when found by you.

Yours ever,
E. A. SCHWARZ

Washington, D. C. Jan. 26, 1897

Dear Hubbard,

Your letter of Jan. 20th giving a most interesting description of Yuma and its surroundings came to hand this morning. It must be a queer country and the scenery along the Colorado River must form a striking contrast to that you have been accustomed to at Tucson. From the entomological standpoint your

account is not very encouraging since the most favorable locality, viz. the bottom land and the river banks seem to be rather inaccessible on account of the freshets. As I wrote you before, a great many species of Coleoptera have been described from Yuma but perhaps not so much on account of the favorable locality as because all entomological visitors to Arizona stopped at this point. However if the climate agrees with you and if you are satisfied with the hotel fare, the surroundings and especially with the entomology I think you would be wise to stop over again upon your return from San Diego.

We had at the Department several times Screw beans (*Prosopis pubescens*) but as far as I remember never had anything from them except the common Mesquite *Bruchus* (*B. prosopis*) and a new species of the same genus (this from pods sent from San Diego), but LeConte and Horn record *B. desertorum* and *B. uniformis* from screw beans. No Anthonomus has ever been bred from these beans but it is quite possible that a species lives therein.

The plant you inclose has been named by Coville *Pluchea servicea* (compositae). This he says is the correct name but the plant is also known as *Tessaria borealis,* the specific name indicating that it is the northernmost species of a tropical genus. The weevil you found on this plant puzzles me greatly. If it is an Otiorhynchid it must belong to Cyphus of which two species are known from Arizona (no exact locality recorded; we have one, *C. lautus* from Morrison) for besides the desert genera Ophryastes and Eupagoderes no other large-sized Otiorhynchids are known from Arizona. But then your description does not "function" at all with the two Cyphus. If it is a true Curculionid I cannot even guess at the genus.

The Dysdercus-like Hemiptera from milkweed belong all to the genus Lygaeus; the species you sent before looks very much like our common *L. reclivatus* which abounds here on Asclepias.

I see that you sent to Howard a box with some decaying pulp of *Cereus giganteus,* and the consequence is that Pergande's insectary swarms with the *Dactylosternum,* Pelosoma, *Paromalus* and the Staphylinidae. Pergande's object is to breed the Volucella but he has already satisfied himself that it is *Volucella*

avida O.S. Of the same species you sent with your invoice 3a a puparium found in Cactus and the fly has hatched here.

I have to take back everything I said in my last letter on the Termite from Cereus. It is simply *Calotermes castaneus* and what I considered as workers are simply the larvae of sexed individuals. The soldier of this species has never been described.

I am of course very curious to know whether the Colorado River will give up to you some of its entomological treasures, and I also hope that you will have escaped that terrible cold wave which is now upon us. From Bulletin No. 20 of the Arizona Agricult. Exper. Stat. entitled "Arizona Weather" I see that the mean temperature of February (at Tucson) is perceptibly higher than that of January but low temperatures and rain may still be expected. The real spring with a temperature fit for camping out does not commence before April.

Yours ever

E. A. SCHWARZ

Washington, D. C. Jan. 30, 1897

Dear Hubbard,

Your exciting account of the Colorado River bottom exploration reached me this morning with the tin box containing screw beans and Tachardias, and the registered box I found in my house two hours ago after return from office. Of course I at once opened the boxes to see whether anything had come to life again but the contents seem to be allright. Now, you can not expect that I can give you right away a complete list of this astonishing array of coleopterological treasures you have brought together within a few days. The mere aspect of the topmost layers (I do not dare to dig deeper in the boxes at present) is overwhelmingly grand, even colossal or rather pyramidal. Tomorrow being fortunately Sunday I expect to do a good deal of mounting and if I am not troubled by unexpected visitors I hope to give you tomorrow evening a rough preliminary account. For this reason I abstain to speak now of the many varieties and novelties which my eye caught upon opening the boxes. I merely wish to mention that your large weevil on *Pluchea sericea* is to my great surprise *Centrocleonus molitor* Lec. I was not

aware that any species of the Cleonus group could be found in abundance upon a partical plant at day time.

Among the screw beans one Bruchus was found to have hatched. It is quite different from the common Mesquite species (Bruchus prosopis) and for the present quite unknown to me.

The Tachardia is not in the collection of the Department and according to Pergande a new species.

In your letter you refer to various things which you have written to me but since your letter of Jan. 20 I received nothing from you until your letter of the 24th. I would be very sorry if a letter from you written about Jan. 22nd should have been lost.

I have put one of your boxes to soak and have now to mount the contents. More tomorrow.

Yours ever

E. A. SCHWARZ.

Washington, D. C. Febr 1/97

Dear Hubbard,

Last Saturday I acknowledged briefly the receipt of your letter of the 24th and of your grand Colorado River collection and this morning (Monday) I got your letter of the 25th. The most welcome news therein is the gratifying account of the state of your health, and I do not see any reason why your lung trouble should not disappear entirely before next summer under the influence of the Arizona climate and of your constant outdoor exercise. I was also glad to stand corrected as to my views of the Arizona winter climate; that weather Bulletin issued by the Ariz. Agric. Exper. Station from which I gathered my information seems to be somewhat misleading.

I am at a loss to locate the parasite you found in the dead wasps (Myzine sp.) It cannot possibly be a Meloid for their larvae are, strictly speaking, not parasites and are predaceous, living first on the egg and then on the honey of bees. It cannot be a ♀ of a Stylopid, for any Stylopid would die as soon as its host dies. I do not dare to investigate closely the contents of the dead wasps for fear of injuring the parasite and only hope that we will be able to breed it. It may be a Conopid (Diptera) larva.

Saturday evening and the whole of yesterday (Sunday) until 12 o'cl. midnight I spent in mounting your Yuma collection but in spite of the most assiduous work I succeeded only in mounting the contents of the two boxes with small and delicate things, that of Jan. 21st and the corresponding box of Jan. 23rd. Both contained an astonishing number of specimens and the number of species represented by them is unusually large. But still more astonishing is the large number of species which I never saw before, and these two pill boxes alone constitute a large and important addition to our collection. For want of time I am utterly unable at present to give you anything like a list of your species and must confine myself to a running comment of the species mentioned by yourself in your letter of the 25th. I will merely add that several of the rarest species are not mentioned by you, e. g. a new genus of Murmidiidae (near the Colydiidae) which is a most inconspicuous, little, round black beetle, greatly resembling the Floridian *Scymnus utilis* (which feeds on *Aleyrodes citri*), *opaque* and *hairy* and not to be confounded with a new *Clambus* (contractile, very minute Silphid) and a new *Cybocephalus* (contractile, SHINING black) of your collection, nor with a small Scymnus beaten by you from shrubbery Jan 20th.

The "large Clivina," 1 spec. Jan. 22nd is evidently not different from the common C. dentipes but has originally been described by LeConte from Yuma as a distinct species. The "Palaminus" mentioned by you I cannot find; should you mis-
(I meant *Pinophilus* H.)
take for it a common S——— (S. longi ———) which you took frequently on Jan. 21, 22 and 23rd? A Palaminus (pallipes) has been described by LeConte from Yuma and is not represented in our collection.

"Small Chlaenius . . . with orange elytral spot" is *Ch. ruficauda* Chaudoir, a common Mexican species extending into Arizona where it has not often been collected. We have only one specimen in our collection without locality.

"Larger Chlaenius with white legs" is *Ch. leucoscelis* Chevrolat, not rare and rather widely distributed in the U. S. and Mexico.

"3 specimens of a small clearbrown Tenebrionid from top of a barren hill" is *Anepsius delicatulus* Lec. which extends from Southern California to western Texas. It cannot be rare.

"Large white Heterocerus is *H. gnatho* known only from So. Cala and adjacent parts of Ariz.; the smaller spotted species is H. collaris, widely distributed; the still smaller very pale species is H. pusillus, also widely distributed. All three species are, however, much whiter than any other I have seen.

The Dyschirius have not yet been investigated; your "smaller Clivinas" belong to *Schizogenius* (2 species) which genus is readily known by the longitudinally sulcate head.

Of your Aphodiidae none belong to the genus Aphodius but they are all Ataenius not yet studied; one of them, a very elongate one, (1 specimen) looks strange to me.

The Blapstinus has not yet been investigated.

That the fauna of your Colorado River bottom is not exclusively composed of varieties is shown by some of your Chrysomelidae: there is the cosmopolitan *Crepidodera helxines* Linn. (bright golden green with yellow legs and antennae); and your "Metachroma" which is the common Strawberry leaf-beetle, *Paria sexnotata* (or *Paria aterrima* when entirely black); the Disonychas also look very common though among these striped species Arizona possesses one peculiar species.

Your "Macrops" from willows is a Dorytomus which has also been found by you at Tucson. Most of your "smaller Curculionidae" will be *Anthonomus pauperculus,* found by you at Tucson in number.

Your Anthicidae are all good but I think you will find them in greater abundance and additional species later in the season when the river is low. The "black one with two yellow elongate spots on the elytra, one on each side" is *A. tenuis* Lec., described from Yuma and new to our collection. "The still more elongated and ghost-like in form, testaceous, variegated with black" is the true *Mecynotarsus delicatulus* Horn which since LeConte's time has never been found again; new to our collection; I was most delighted to see this, for it enables me to describe intelligently my new species from San Diego, Texas. Your "perfectly colorless Mecynotarsus" is either a new species or a variety of

M. delicatulus. I hope you will be able to get more specimens of these two Mecynotarsus; later in the season they should be not rare on the dry sand banks (though very few entomologists have been able to find the species of this genus).

Your "*Listrochelus*" are one or two species of *Diplotaxis* about which nothing can be said at present. You will find various other species of this genus. The true Listrochelus greatly resemble small Lachnosternas and will be found flying at and after dark later in the season.

The "stout Aphonus" is I regret to state the common *Ligyrus gibbosus.* Some larger and very little known allied species are, however, liable to occur in southern Arizona.

The Tropisternus is the same common species you found at Tucson; the small Philhydrus may be something good; the *Laccobius* is *L. ellipticus* but there are among them two species of a *Chaetarthia* which may be different from the eastern *C. pallida.*

The small Carabidous species so plentifully represented in your collection is not yet investigated; it suffices to say that your Bembidi*ums* do not represent a very striking appearance but I notice among the small ones a unique example of a distinct species. Three species of Tachys are abundantly represented but of a 4th species pale HONEY yellow, DEPRESSED with LONG antennae, evidently something extraordinary, I see only one specimen.

The "elegant very small black Lebia with a spot on the elytra" is the widely distributed *Axinopalpus biplagiatus.*

Now to your great prize in the Carabidae! They are really extraordinary. Of the two "*Zuphium,*" the smaller, with large head, less punctate etc. is *Z. mexicanum,* new to us; the larger one with evident punctuation is a Thalpius not yet determined and also new to us. Neither of these two were found by LeConte at Yuma. The small "Carabid not shining with pellucid appearance" is the rare *Pericompsus sellatus* Lec. described from Yuma. We have 3 specimens given by Capt. Casey labeled "Cala". but probably collected at Yuma.

The Brachinus is not yet investigated but it belongs to the Pacific series of this group.

The snow-white Eumolpid is the best preserved specimen of Glyptoscelis I have ever seen; it is *G. squamulatus* known to

occur in So. Cala. and Ariz. The smaller allied species is *Myochrous longulus* Lec. known only from Yuma.

Of the rest of your collection I shall write tomorrow and only mention here that your "brilliant orange-red colored Staphylinid like a Paederus" of which you took a good supply is *Paederus ustus* Lec. known only from Yuma. To this species I called your particular attention on the last day you were at Washington and showed you then the specimens in our collection given by Capt. Casey.

I have now to go to work to mount another lot of your Yuma things which I put to soak before commencing this letter.

Yours ever

E. A. Schwarz

Washington, Febr 3/97

Dear Hubbard,

Before all I must congratulate you upon your splendid success in bringing to light the fauna of the Colorado River bottom. I have thus far received (and fortunately almost entirely mounted) only the lot you sent with your letter of Jan. 24 (this lot I have numbered No. 5) and to which I referred in my last letter. Since that time I have received your letter of Jan. 25 and this morning came your letter of Jan. 28th both referring to the continuation of the river bottom investigation. From your immense collection I perceive now that the fauna of the lower Colorado River valley is not only much richer in species but also of much greater importance for the knowledge of geographic distribution than it has hitherto been accepted and your collection alone fully confirms Dr. Merriam's claim for the lower Colorado valley as a distinct faunal region. As I wrote you before there are many previous records of species taken at Yuma but with many other species the records have been confused and obscured by careless labeling and the species have been described simply from "Arizona" or "California." Your collection contains a large proportion of species which no doubt are peculiar to this fauna but many more remain to be discovered, for, in spite of the warm weather you boast of, your collection has a decided winterly adspect and the phytophagous families which

contain the species most characteristic to a tropical fauna are not represented. There are hardly any Elateridae, no Buprestidae, no Lampyridae, no Malachiidae, hardly any Ptinidae, no Cerambycidae, no Meloidae, hardly any Chrysomelidae and Curculionidae. All these will come later and will represent many peculiar forms.

To continue my report left unfinished in my last letter:

"The largest Philonthus, dark species with red elytra" Strange to say, this is not in our collection and may be undescribed.

The Pinophilus is *P. densus,* new to our collection, described by LeConte from Yuma.

"Brilliant orange red Staphylinid like a Paederus" is *Paederus ustus* Lec. as I wrote you already.

No *Homalotas* are among the lot but a Tachyura (good looking species) Aleochara bimaculata (cosmopolitan); a small thing allied to *Aleochara* with the ♂ having a concave thorax (apparently new to us; a new species of Myrmecochara (a very short, light brown, rather hairy species, strictly myrmecophilous).

Among the Steni are two, possibly three, species, the largest with yellow legs, is *St. gilae* described by Casey from specimens collected by LeConte probably at Gila Bend.

The very minute pallid Hypocyptus I have unfortunately not yet found but may still turn up.

The "very abundant Pselaphid, very small, exceedingly short and stout" is *Scalenarthrus hornii* Lec. (the genus and species is new to our collection) described from specimens found by Dr. Horn at Camp Grant.

"One specimen of the Trimium which I found so common under willow leaves on the opposite shore" There is not a single specimen of Trimium in the lot, but numerous specimens of the Lathridiid *Holoparamecus pacificus* Lec. which has no doubt been mistaken by you for a Trimium. The same species is (2 specimens) among your beetles from *Cereus giganteus* and is apparently referred to in one of your letters as an *Enthia*. Among this Holoparamecus there were also several specimens of a Smicrips which probably does not differ from the Floridian *S. palmicola*. Of the *Holopar.* we have two specimens from the Morrison collection.

Of the 3 species of "small, round black beetles"—*Clambus* n. sp.;—*Cybocephalus* sp.; new GENUS of Murmidiidae—I think I wrote you before.

The Hemiptychus is different from our eastern species but in nowise a striking species. The "Throscus with hoary pubescence" is one of Californian species, its hoary pubescence proved to be a mixture of river mud and ordinary pubescence.

Of the species mentioned by you in your letter of Jan. 25th I would guess that the Ega must be *E. laetula* which is not in our collection.

Species mentioned in your letter of the 28th: Of Scarites we have only one species in the U. S., *S. subterraneus* which, however, develops marked geographical races.

The "Listrochelus" mentioned by you before is always a Diplotaxis of which various species will be found by you in Arizona.

The "very large black Saprinus" will be nothing but *S. lugens* which is common throughout the southeast. "The very small, brown Histerid without striae" I take to be *Abraeus bolteri* Lec., a rare species of which one specimen was given us by Mr. Fall.

The Platynus I cannot name with certainty; the only dull blue species from Arizona in our collection is *P. funebris* Lec. I regret that I have not yet any name for your common brownish *Blapstinus*. The 12-spotted pea-green Diabrotica is *D. tenella* Lec. considered as a race of *D. 12-punctata*. Your *Galerita lecontei* may be *G. californica* Horn which would be new to us.

I forgot to mention that besides the Scalenarthrus and the Ctenistes there is a third Pselaphid in your collection viz. a Bryaxis, probably *B. texensis* Brend. which is new to us. *Bius estriatus* does not occur in Arizona but I cannot make a guess at it and just so I am unable to tell what your rare Tenebrionidae and Curculionidae are. With your Cereus species it was a comparatively easy thing to guess at the species because we had to do with a definite food-plant but with Tenebrionidae and Otiorhynchidae it is quite a different thing.

I wonder what experience you will have in California. If you find time to devote to entomology you will find of course many species which are unknown to you but the proportion of "good

things'' you will turn up will be much smaller than from Arizona for the San Diego region has been hunted over by Coleopterists: LeConte, Horn, Crotch, Koebele, Casey, Coquillett, Blaisdell etc. Ulke got quarts of beetles from San Diego which were collected by a gentleman, Mr. Sanford, who was City engineer of San Diego but of whom nothing has been heard from of late years, However I believe that by ''thoroug'' collecting some unusually fine thing are still to be found there.

As you see from the enclosed sample of labels I had made some feeble preparation for your Yuma and San Diego trip. ''Yuma'' being such a short name I had to lengthen as best as I could but should you stop over there on your return trip I am afraid I have to print another edition.

I wonder whether you will find all my letters and that box of cigars. Let me know in time of your future movements so that letters and packages are not miscarried, and remember that it takes at least 10 days before you get any answer from me to any letter written at San Diego.

Yours ever,

E. A. SCHWARZ.

Washington, D. C., February 4, 1897

Dear Hubbard,

Upon coming home yesterday evening I found your box containing the second installment of the Colorado bottom exploration (this lot I have labeled lot no. 5a) sent with your letter of Jan. 28th. Unfortunately there was in the evening a meeting of the Joint Commission of Scient. Societies of Wash. which I had promised to attend. So I had only time to open the pill boxes and take a glance at the topmost layers. Still more unfortunately there is to-day the regular meeting of the Entomolog. Society (address of the President), and tomorrow night a lecture by Fernow on the ''Gardens, Forest, and Deserts of Arizona which I cannot miss. Thus I am unable to continue to work on your specimens before next Saturday. However, I made hasty notes on a few things I saw in the boxes:

The *Ega* is *E. laetula* described by LeConte from the Colorado River; he says ''not rare in March in wet places along the river''. New to our collection.

The "beautiful large iridescent Carabid" is *Pterostichus* (*Poecilus*) *subcordatus* Lec. (new to us) of which there was a single, less brilliant specimen among your lot No 5.

The Platynus is not *P. funebris* as I wrote yesterday but does not appear to be a rare species.

The more I look at your larger "Zuphium," which is probably a Thalpius, the stranger it appears to me. I was yesterday for a moment at Ulke's but did not see it in his collection.

The "very common looking Stelidota" is a Cryptarcha (Nitidulid) which looks rather good and may prove to be different from the eastern species.

The "remarkable Tenebrionid, oval, covered with snuff-colored pubescence, and with alternate elytral ridges" is very remarkable indeed, quite unknown to me and I cannot place it at present.

The "short robust Lamellicorn dug out from the sand" looks very good; it may be a Diplotaxis but is quite different from that you found among the debris.

The "two specimens of a remarkably long-legged Otiorhynchid" belong to *Eupagoderes decipiens* of which you found two specimens at Tucson.

The "pretty little pale-red and translucent Tenebrionid from the top of stony hills" is something extraordinarily good; it is the rare genus Batulius of which two species were described by LeConte from the "desert of Gila" Possibly both species are represented among your specimens.

Your largest Philonthus, black with red thorax and elytra of which I wrote you has been located by me; it is the rare *Ph. innocuus* described by Horn from "Arizona" and new to our collection.

Among the very small things I am delighted to see a good supply of that new genus of Murmidiidae and of the new Clambus.

I am of course very anxious to send you a revised list of your Cereus giganteus fauna and of your Yuma collection but so far I have been too busy with mounting to have any time for determining. I shall, however, try my best and send you at least the Yuma list before you visit the place again.

I wonder whether I acknowledged to you the receipt of the bundle with sticks of Prosopis and Larrea. Nothing has come

out so far but something is working furiously in the Mesquite branches; in the Larrea twigs no life is visible though they look promising.

Yours ever,
E. A. SCHWARZ

Washington, D. C. Feby. 15/97

Dear Hubbard

After hard work I finished yesterday (Sunday) the mounting of everything you have sent on from Tucson and Yuma and intended to commence to-day a list of your Colorado bottom collection when this morning I received your grand Dinapate—Palm Springs—and Colorado desert letter, dated Feby. 8th with accompanying box of specimens.

. . . .

This afternoon I spread out a little the contents of your box and found everything O. K. I do not propose to write now about the San Diego material in detail but merely wish to say that it is a most valuable addition to our collection since our material from lower Cala. is badly labeled and otherwise in undesirable condition. I am greatly pleased with the variety of species contained in the lot: that solitary Copturus is a beauty, evidently *C. mammilatus* Lec. which I never saw before and which is new to our collection. In my letter you will find at Indio I indulged in some guessing at this San Diego lot: one incorrect guess was that at the whitish Curculionid you found so plentiful on a downy-leaved plant. It is *Trigonoscuta pilosa* Mots., a maritime species found all along the California coast but quite accessible to our collection, for we have not a single specimen with exact locality.

Now to your Palm Springs account! From the little I succeeded in extricating from Mr. Coquillett I knew that you would be pleased with the locality, and I only regret that you were not there 3 months later when according to Coquillett the desert and cañon plants swarm with insects. I regret that you worked so hard to get that Dinapate but your account of the habits and burrows is certainly worth a quart of the beetles even at $1,300

apiece. The mere reading of your account is worth about half that amount. I take from your account that the larva bores in healthy trunks of Washingtonia [''No, but not in old dead trunks.'' Hubbard] Do you think that the beetle is peculiar to this palm? [''Yes.'' Hubbard.]

To go on with your account of your explorations in the Dinapate cañon:

. . . .

''Large rich-deep-blue Chlaenius'' = *Chlaenius cumatilis* Lec. peculiar to southern Cala. and most welcome to our collection where we had only a few miserable specimens without definite locality.

''Smaller dark (greenish) species of Chlaenius (1 specimen)'' = *Chl. obsoletus* Lec. also peculiar to the extreme southwest. We have a few specimens from southern Cala. from Ulke, and from Kern Co., Cala. (Morrison.)

''Extremely abundant large flat Platynus brown with lighter thorax'' = *Pl. brunneomarginatus* var. *bicolor* Lec. The typical form (entirely piceous-black) is common throughout Cala. The variety, which in the Biologia Centrali-Americana is considered as a distinct species is a southern race peculiar to southern Cala., Ariz. and Sonora. We have several from Ariz. (Morrison.)

''Most elegant, opaque, black Platynus'' = *Platynus funebris* Lec. not rare in southern Cala. Under similar conditions you will find in Arizona an allied, more shining species, Pl. cyanopis Bates.

. . . .

''Small Sphenophorus about the roots of plants.'' This is a beauty and apparently = *Sph. arizonensis* Horn, described from no exactly defined locality and new to our collection. The specimens coated with a dirt-colored covering, I take to be the same species.

''Tenebrionid under stones at mouth of small cañon, covered with coarse brown pubescence, thorax globular with sharp tubercles at front angles, etc.'' This is *Craniotus pubescens* Lec., a genus new to our collection and a great rarity. Ulke has only one specimen and there are none at the Nat. Museum. Described

by Leconte from a single specimen found dead at Vallecita (some distance south of Palm Springs). Dr. Horn is the only one who found a number of them in the Maricopa Desert of Arizona under logs.

"Other Tenebrionid, long and parallel in form, black (glabrous), elytra striate and coarsely punctate, etc." = *Cerenopus concolor* Lec. of which Horn (Revision of Tenebrionidae) says: "Occurs on the borders of the Colorado desert and on the northern end of Baja Cala." It is evidently a very rare species of which there is only one specimen in our collection without any locality (given to you by Dr. Hagen). Among this species there is however in your lot ANOTHER species of the same genus (one specimen), slightly more flattened, the thorax wider and with the sides decidedly sinuate. It is quite unknown to me.

Not referred to in your letter but from the same locality and date there is an *Argoporis bicolor,* Tenebrionid, somewhat smaller than the Cerenopus and with red legs. We have it from Morrison's collecting from Arizona. There are further 2 species of Eleodes, one with spinous femora, the other very slender and extremely good looking.

Should this letter still reach you at Palm Springs please do not neglect these large Tenebrionidae of the desert land. Our collection is extremely poorly represented in this desert fauna and you may expect to find quite new species.

. . . .

Yours ever
E. A. SCHWARZ

Washington, D. C., Febr. 10, 1897

Dear Hubbard,

Last Thursday the regular meeting of the Entomol. Soc. of Washington was held at Mr. Marlatt's new house. I think I wrote you that Marlatt got married last December to a girl with a mother who owned a nice house on Massachusetts Ave. A few days after the wedding the old lady was kind enough to die after a short sickness and Marlatt is now in the possession of a young wife and a fine house undisturbed by any mother-in-law. Last Friday Fernow's lecture on the deserts and forests of Arizona

came off. It was greatly interesting to me on account of the many beautiful and new lantern slides exhibited. Most of the views represented the forests on the plateau and San Francisco Mt. but there were also some of the slope of the "rim" (some distance south of Flagstaff) and a few from the desert region. One in particular interested me viz. a view of a large, cool brook in the Sta. Catalina Mts. bordered by a dense arborescent vegetation; this scenery must swarm with insects.

Last Saturday evening, the whole of Sunday and again Monday and Tuesday evenings I have been hard at work at your Yuma collection. I have made considerable progress but I am far from finishing the lot. The two boxes containing a multitude of small things cause great delay. New things are constantly turning up and the number of species represented in your Colorado bottom exploration will be much greater than you suppose. This fauna is evidently difficult to bring together on account of there being so many closely allied forms, i.e. species which cannot be distinguished while collecting. I think you will have noticed that nearly all Staphylinidae from the Colorado bottom are nearly the same coloration, being more or less bright orange-red, and it is among these that uniques most frequently occur. Thus I found among your duplicates of *Paederus ustus* a single Lathrobium which so resembles the Paederus that I almost overlooked it. Among the yellow Tachys I found 4 species, two of them represented by uniques, the two other by plenty of specimens. Even among the larger species I make unexpected discoveries. There is a third species of Chaenius, 2 specimens, greatly resembling the *Ch. leucoscelis,* and among your Blapstinus there are no less than 4 species, one being represented by a single specimen.

The largest of your Bembidium (strongly bronzed) is *Bembidium carinatum* Lec., described from the Colorado River and new to our collection. The larger Blapstinus like Tenebrionid with alternately elevated elytral interstices is *Trichoton sordidum,* described by LeConte as a Blapstinus. Horn says of it "not rare at Camp Grant, Ariz. under logs."

To my great disappointment I am obliged to withdraw all I have said about that new genus of Murmidiidae; it is simply the genus *Bothriophorus* of the Byrrhidae, described by LeConte as

Physemus minutus from the Colorado R.; but the genus was new to us.

I do not believe that while collecting in the Colorado desert you will be particularly interested in the Colorado bottom insects. I will, therefore, do my best to prepare and send you a preliminary list of this fauna to Yuma so that upon your return to the place you may find it there. It is of course impossible for me to calculate when you will get to Yuma but I hope to receive in your next letter further directions. I also would have returned you the empty boxes long ago but hardly dare it now as long as you are traveling about in the desert. Write to the postmaster of Yuma to retain any letters until you call for them.

Yours ever,

E. A. SCHWARZ

Washington, D. C., Feb. 19/97

Dear Hubbard,

I wish that the distance between the Colorado desert and Washington would be not so great, or at least that the railroad would run about 10 times faster than it does now; and secondly I wish I had a little more time to spend for the mounting and determination of your collections so that I could report on your insects quicker than I am able to do now and that you would get the information while you are still at the same place. I answered your first letter from Palm Springs and the first lot of the Palm Springs insects (lot 6b) as soon as I possibly could but I am no by no means sure whether my letter will still find you there. Since you intend to spend some days at Yuma I have made out a preliminary list of your collections there made between January 20 and 28 and have forwarded the same in 3 installments, dividing your collection into 2 parts, the River debris collections, and the collections made otherwise. The list may be of some use to you during your second stay; of course it has been made up hastily and the determinations are subject to corrections upon more careful examination.

Your first stay at Yuma was indeed a grand success, the whole number of Coleoptera collected by you in a single week amounting to about 200 species! among which there is an astonishing

large percentage of species new to our collection, and this number will no doubt be still increased upon closer study of the more difficult forms. If you stop over again at Yuma for some days I hope that you may get a little warmer weather so that you may see some of the spring species. Some easily recognizable and large species which must be common at Yuma at some season are not represented in your collection *e.g.* the genus Omophron (*O. gilae* Lec. "from the margins of the Gila River, Ar."; *O. dentatum* "on the banks of the Gila River at Yuma, Ariz.," and possibly also *O. obliteratum,* a single specimen collected at Camp Grant, on the San Pedro, a tributary of the Gila, Ar."), the genus *Oodes* (*O. elegans* Lec. "occurs in Arizona along the banks of the Gila River") of which one species *O. elegans* is a brilliant species, dark bronze with golden-green margins. We have it from Morrison's collection and lately Mr. Fall gave me a lot found at Yuma. If the river is low you may find these things at the edge of the stream; other species not found by you before are sure to occur on dry, fine sand, especially at the roots of plants. But I am afraid that even at Yuma this dry sand fauna will be quite late to appear. The *Eleusis fasciata* is certainly not confined to Cottonwood bark and you may find it also under willow bark but only of rather freshly felled trunks or stumps where the bark still retains some moisture.

Your second letter from Palm Springs and second invoice (lot 7 which of course will be united with lot 6b) came to hand this morning. What a wonderful locality this oasis in the desert must be; I read your letter to Coquillett and he became quite enthusiastic in his praise of this locality which upon referring to his note book he visited early in May and when he and Dr. Davidson drove up to the cañon. I wish you would have a chance of seeing this place late in the season. I have spread out a little the contents of your boxes and while I see *many* things quite strange to me I am quite surprised at the character of the fauna. I expected that you would find almost exclusively desert forms but the largest portion of your collections consists of riparian forms! And what a difference between this fauna and that of the Colorado River! I cannot enter into particulars now but within 3 days (the 22nd is fortunately a holiday, Washing-

ton's birthday) I shall be able to give you more detailed information. Of course I duly admired your Dinapate, this almost antediluvian species which has no right to exist in our days. It is not to be desired that the specimen is, to express it mildly, somewhat damaged but if a perfect specimen is worth $1300, I place the value of your specimen at about $688.75. But now what to do with the specimen? I do not dare pin it and it is too big to glue it on paper.

Your Thelyphonus-like spider creates a sensation here. Mr. Banks has consulted the literature and suggests that it can enter the famile Schizonetidae of Thorell, allied to the Thelyphonidae. It is, however, a new genus and nothing similar has ever been found in Amerika. The peculiar anal appendage may be sexual.

Yours ever,

E. A. SCHWARZ

P. S. A box of cigars is herewith sent by mail; also, under Department frank a box of large vials, all addressed to Palm Springs, Cala.

Washington, D. C. March 5/97

Dear Hubbard,

After several days of anxious waiting I was extremely glad to receive this morning your letter of the 27th. The box has not come along but will probably he here tomorrow. You do not write about the state of your health but since you are climbing inaccessible canons and precipices I presume you have no reason to complain in this respect. I am glad that you find Palm Springs such an interesting and comfortable spot although I presume it was not a very pleasant place during those cold days with accompanying snowstorms. The only thing I regret is that I could not foresee your change of plans and that you will have some trouble in getting your mail. My last letter to you written some days ago in reply to your letter of Feb. 17 I directed to Tucson but I returned three slide boxes each containing 10 cigars (2 of them I think to Yuma) and also two packages with author's extras of your Ambrosia paper. Furthermore, had I known that you would remain longer at Palm Springs I could have worked at the determination of your Coleoptera from that place, but so I spent all my time over your Tucson material.

I am extremely glad that your exertions to find a colony of Dinapate have finally been crowned with success, and no matter whether or not Dr. Murray will be able to get the beetles this summer your observations are extremely valuable and well worth publishing. I have never seen a photograph of the Washingtonia and was greatly astonished in reading your account of the grandeur of the palm. Should your conclusion that Dinapate exclusively lives in this tree be correct, the species would form an exception to the polyphagous habits of most, if not all other species of the family Bostrychidae. I read somewhere that in the desert regions of California certain Convolvulaceae have enormous subterranean tubers which appear to me well adapted to furnish room and foot for large Bostrychid larvae. If the conditions under which Dinapate can propagate are so rare as you describe, I should think, the species would have become extinct long ago in California since I am not aware that there are anywhere large forests of this palm.

The remaining portion of your letter proved to be just as interesting especially the portion relating to myrmecophilous species. I fail to recognize any of these species and the same may be said of the other rarities you mention. As a rule I find that this Palm Springs fauna is much more difficult to identify from your description than the material you found at Tucson or Yuma; partly because there is absolutely nothing recorded from the Palm Springs regions and partly, as I wrote before, because the fauna there is so extremely composite. The "large gracile Scydmaenid" found among ants cannot be a *Cephennium* which are all oval or short-oval. The "red myrmecophilous Staphylinid" is apparently an undescribed species of Casey's genus Platymedon (near Lithocharis and Dacnochilus) of which I saw a Californian specimen in Ulke's collection. The "colorless Bembidium" is probably the really beautiful *Tetragonoderus pallidus* Horn of which I bought one specimen for 50cts from Wickham who found it at the Needles in Arizona. As I said there is no use for me to make further guesses and I shall wait until the specimens come.

Glad to see that you remember that lovely Ptinus from Yuma which had come to life in your boxes, as I can now label it cor-

rectly. I see that in the Yuma list I forgot to mention that one specimen of *Bruchus* n. sp. from Screw bean.

We are of course all upset here not so much on account of the enormous crowds which are here for the inauguration but in expectation regarding our new Secretary, Mr. Wilson of Iowa. He has been Director of the Iowa Agr. Exp. Stat. and if one would believe rumors he is just the same sort of politician as your friend Prof. Meyers of the West Virginia Agr. Exp. Stat. The new Assistant Sec'y, Mr. Brigham of Ohio is also a politician; so we do not know what the next future will bring us. There is also here a great gathering of delegates of the State Horticultural Societies from all parts of the country to confer about general legislation against the importation of injurious insects. Various entomologists, J. B. Smith, Slingerland, Garman of Kentucky and Atwood are among the delegates. This would not trouble me greatly but unfortunately each one has brought along a big box of specimens for determination. So I shall be extremely busy this evening and tomorrow and not able to work at your Coleoptera.

Yours ever,
E. A. SCHWARZ

2nd letter Washington, D. C. March 5/97

Dear Hubbard,

As a postscript to my letter written this afternoon I would say that Mr. Lugger has also arrived to swell the crowd of entomologists who bring big boxes of beetles for me to determine. The prospects for my doing any work over your beetles during the next two days are very dark. Further I wish to say that your box No. 7c has safely arrived. I have just come home from the Cosmos Club where I had invited Smith & Lugger to dinner (at no other place in the city it is possible to get something to eat since we have about 150,000 strangers with us. Nor is there any place to sleep and both Smith & Lugger have just departed for Baltimore to return tomorrow evening) and opened the various pill boxes but did not dare to dig deep in the layers. I see a great many things which are quite unknown to me but only a few of those you mention in your letter. The "large

gracile Scydmaenid'' is really a marvellous thing, quite new but closely allied to the European genus *Leptomastax*. Mr. H. C. Fall of Pomona who was here last summer told me he has found one specimen of a remarkable Scydmaenid in southern Cala. and from his description I have no doubt that your species is the same thing.—''Rather large blue-black Carabid, apparently a Lebiid'' is a Metabletus quite new to me and no doubt undescribed (unless quite recently described from Baja Cala.)—''Elongate Silphid near Colon'' This is apparently *Ptomaphagus californicus* Horn, described from southern Cala.; we have only one specimen given by Mr. Fall.—''Very remarkable formicophilous Staphylinid of red color''—this I have never seen before but must be *Apocellus analis* Lec. described from southern Cala.—The ''*Araeoschizus* with dense spiny hairs'' is the same undescribed species which you found at Tucson. It is strange that no one found this species before.—The *Ligyrus gibbosus* ? (Febr. 22) is unfortunately correctly determined; this common Scarabaeid occurs throughout the U. S.—I wonder what your red Embiid will turn out to be. No species of this family is known from the Pacific Slope, but there is probably no chance of your finding a winged specimen at this season. That the species, or at least some of them, are spinning tubes is a settled fact though it was still doubted by Hagen in his Monograph of this family.—The ''Babia with red shoulders, bronze black and hoary pubescence'' is a Coscinoptera which I do not see in our collection.—The ''small slender thing . . . looking like an Araeoschizus . . . smooth but alutaceous . . . with almost invisibly fine pubescence . . . obcordate thorax'' etc is *Cononotus sericans* Lec. described from South. Cala. We have two poor specimens one of which was given us by Dr. Horn. The latter seems to have found this species abundantly (probably at Ft. Tejon, Cala) and he says: ''Adheres to the underside of stones. Occurs in very dry places and is more abundant in early spring. They are generally in colonies and have their heads all in one direction. They move almost as rapidly in hot weather as *Telephanus velox*. To secure a whole colony the head one must be taken first, for if one be disturbed and runs forward among the others, all start'' (Proc. Ent. Soc. Phila. 1867, p. 290).—The ''perfectly colorless

Bembidium'' was correctly guessed by me in my first letter of to-day as *Tetragonoderus pallidus*— Regarding the numerous small Tenebrionidae which accumulate in your collections I am in the same fix as you; I am for the present bewildered with the multitude of them and without a close study I am unable to give at present any information.—Regarding *Craniotus pubescens,* Dr. Horn says in the paper cited above ''Dead specimens of this rare insect were found (probably by LeConte) at Vallecito. Living specimens occurred on the Maricopa desert, under dead stems of *Cereus giganteus,* in the months of March and November''. In the same paper Dr. Horn also mentions the occurrence of *Dacoderus striaticeps* (the genus next to *Araeoschizus*) as having been found by LeConte at Ft. Yuma under Cottonwood bark. ''This was evidently an accidental occurrence. as I found a pair under my medicine chest while camped at the same place'' In the same paper Horn mentions also the occurrence in enormous numbers of the Meloid *Cysteodemus armatus* (with greatly inflated elytra) on the greasewood bush'' of Arizona and the Colorado Desert during March and April; and finally the occurrence, in March and April on the same plant (Larrea mexicana) of the rare Meloid *Phodaga alticeps,* ''while traveling through Arizona.

Yours ever,

E. A. SCHWARZ

P. A. I have printed any number of ''Indio'' labels but no insects thereto. Have you given up your plan of stopping over in the midst of the desert for a day or two?

Washington, D. C. March 21/97

Dear Hubbard,

Since quite a number of days I had been waiting anxiously for a letter from you as I did not know where to address you but finally I got yesterday your letter of the 13th and by going this morning (Sunday) to the post office I was fortunate in finding your box (lot 7 d). Both the reading of your letter and the first hasty survey of the contents of the boxes varied by a casual admiring glance at your ''splendid'' specimen of Dinapate furnished an excellent Sunday entertainment.

I am greatly pleased to learn that you intend to prolong your stay at Palm Springs where you seem to be well cared for and where you made a collection of far greater interest than you seem to think yourself. I only regret that for want of time I have been unable to furnish you more determinations, but as I wrote you before, by far the larger portion of the Microcoleoptera you found there belong to the most intricate genera which require close study, and there will be many new species among them. Even many of the larger forms from Palm Springs I find extremely troublesome e.g. the various species of Blaps and allied genera, the various Horistonotus etc.

The drawings for your Birch Coccid paper do not make any progress at all I regret to state. Pergande says that for want of time it is impossible for him to make sufficiently careful drawings that are fit for reproduction. Some months ago, and several times since, I have spoken to Miss Sullivan about making these drawings on Sundays or after office hours for which work I would pay her. She consented to this but she has been the entire winter over in very poor health, and in fact, has not yet commenced the drawings. If this goes on in this way the only way of publishing your paper is to make an official paper of it to be published in one of the technical Series of the Division. In this way Miss Sullivan could make the drawings during office time.

I sent another batch of your author's extras of the Ambrosia paper to Tucson; also wrote you one or two letters and forwarded several letters in one package. I think I also returned there one of your empty boxes with a few cigars therein. It seems that you have not yet received that letter but among others I requested you therein to send me 50 or 60 slips of white paper with the inscription "With the compliments of H. G. H. etc." to be pasted or laid into your author's extras of the Ambrosia paper which I could mail to your correspondents.

Ever since that Inauguration I have lost almost every evening in one way or another so that I was unable to make much headway in the determination of your collections. To make the misfortune complete I am suffering from a protracted "spring" cold with accompanying attack of rheumatism. However, every-

thing of your collection (excepting of course lot 7d) is mounted and labeled except your first specimen of Dinapate which I am afraid to handle.

From the Screw beans you sent on from Yuma another specimen of that new Bruchus has issued but also one specimen of the common Mesquite Bruchus, *B. prosopis* and a lot of parasites (3 species) From the Sunflower stems you sent from Tucson two little Curculionids have issued both being *Copturus adspersus* which is not rare wherever Sunflowers grow wild. The Cerambycid larvae in the same stems, and also those in the Cocklebur stems are still alive but do not show any inclination to pupate. From the Mesquite twigs you sent me from Tucson, a very queer Cerambycid larva has unfortunately worked itself out so that there is now very little hope of breeding the species. From the Larrea twigs sent from the same place and at the same time nothing whatever has issued so far. The Tenebrionid larvae from the rats' nests are still lively as eels and eat anything that is offered to them including cake and the locality labels placed in the boxes. Unfortunately they do not make the slightest preparation of going into pupa stage.

(I have to mail this sheet now and shall continue this letter tomorrow)

E. A. SCHWARZ

Continuation (3) Washington, D. C. March 22, 1897
Dear Hubbard,

Barring the collection you made at Yuma where under exceptionally favorable circumstances you found an extraordinary large number of species, your lot No. 7 d is one of the most interesting lots you have sent on. Small as it is it contains proportionally more interesting species and more novelties to us than any previous sending. The larger portion of the good things belong to the desert fauna which seems to develop now with the beginning of spring but I am inclined to think that in May or June also the canon fauna would produce any number of species which cannot be found now. I am pleased to learn that the phytophagous desert fauna commences to put in appearance but you must not forget that you will find the same, or a

similar, fauna upon your return to Yuma and Tucson. As to the Dinapate this is evidently a relic of ancient times and Prof Coville informs me that the same holds true with the Washingtonia palm which occupies a quite isolated position in our flora. Since you cannot possibly carry around with you the heavy pieces of palmetto wood you have saved out I would advise you to send them to me at the Department by express, unpaid, and I shall do my best to breed the beetles. I suppose there is no express office at Palm Springs; so you will have to carry the pieces at least to Yuma where you no doubt will be able to find a suitable box. Pack the pieces between some promising dead mesquite branches and they will come all right. What kind of parasite do you suppose infests the Dinapate? It must be at least an hitherto unheard of genus of Braconidae.

The following notes I have made upon a hasty survey of the various layers of your lot 7d. ''Indio, March 2, under mesquite bark''—Do not swear at this locality for the only species you found there is worth several hundreds other species. It is a genus new to the U. S., allied to *Hypophloeus* of the Tenebrionidae, and I have no doubt that it belongs to the genus *Latheticus* of which a single species (*L. Oryzae* Waterhouse) has lately been found in England in rice shipped from India or China. Your species differs, however, specifically from *L. oryzae*.

''March 5. In dead palm bud, Palm Canon.—*Mycotrogus angustus* Horn (Tenebrionid) Two specimens were found by you before at Yuma under willow bark. This is a very rare thing hitherto not represented in any collection at Washington.

March 6—''Small canon. Plant 7'' The bronze-green Halticid is *Hemiglyptus* (*Crepidodera*) *basalis* Crotch, peculiar to southern Cala. Its food-plant is not yet recorded by name, and Crotch, in describing the species, only says: ''San Diego, devastating a blue flowering shrub in the canons round there''.—*Anthicus sturmii* (or a closely allied species) which we found rather commonly on shrubbery in the canons of the Wasatch Mts. Utah.

March 6th ''Valley''—I am delighted to see two additional specimens of that 2nd species of *Cerenopus* with the minute thorax and slightly tuberculated (not punctured in rows as in

C. conicolor) elytra. I am inclined to think that it is a new species though it may be known from Mexico.

March 8. ''West Canon''—Here is a beautiful small Bembidium—bright bronze green with yellow legs; elytral punctures not in impressed rows—which I have never seen before new to our collection.

March 9—I am afraid that the Hydraena does not differ from the widely distributed *H. pennsylvanica* which you found commonly at the Bear Paw Mts., Mont. and in the canons of Utah, in the Yellowstone Nat. Park etc. The very small Hydrophylid is *Limnebius piceus* Horn, also widely distributed in the West. It is certainly very strange that the Palm Springs locality does not seem to harbor a single good water beetle except that small Bidessus which, for the present, I fail to locate.

March 9. ''Palm Valley, desert plants''—*Hemiglyptus basalis* (see above)—Dasytes sp.—elongate, unicolorous dark bronze above, pubescence very inconspicuous—a very good-looking species not in our collection—*Listrus,* with fasciate elytra, either *L. luteipes* Lec. or an allied species —*Allonyx* sp.—about the same size as the preceding, unicolorous above, with very neat yellowish-grey pubescence, thorax with an impressed line each side, not in our collection; also represented in your lot 7c.

March 11 ''On *Dalea spinosa* in desert washes''—Neither the white Apion nor the Tingid I have ever seen before; both are beauties. Among the Smicronyx there are two species, the mottled one, which you found before at Tucson, Yuma and Palm Springs and a much rarer one with very large yellowish scales (easily abraded) also represented in your lot 7c.—The grey Brachytarsus, with two large, blackish elytral spots, also sent by you in lot 7c is a new species which I did not see before.

March 11 ''In herbs in desert lands''—Most delicate ''Reduviid'' This must be something good.—''Small Collops'' This is *Attalus cinctus* Lec. peculiar to the Southwest. I think that various other species of this genus will become now more or less abundant in your locality. This particu-

lar species we have from the Morrison collection but since no precise locality is attached to this nor to any other species, all species of this genus are most welcome to our collection.

March 11.—"Sandy washes, Palm Valley"—A very fine series of *Cononotus sericeus.*—*Araeoschizus sulcicollis,* the Californian species which is not among those you found at Tucson. Whether or not any species of this genus are myrmecophilous is a question not yet settled.—Very small blackish Tenebrionid with pale legs. I think this must be the true *Anepsius delicatulus* which should not be rare in southwestern Arizona.

March 11 "Desert sand under sticks, Palm Valley"—I do not wonder that this collection reminded you of the Colorado beach at San Diego, for, sure enough and to my great surprise, the whitish Otiorhynchid is indistinguishable from *Trigonoscuta pilosa.* This seems to be hardly credible for this species has always been considered as strictly maritime. However it must be remembered that not so long ago, perhaps only a million years, the Colorado desert was a part of the Gulf of California—Your second species, the Coniontis" looks indeed very much like the *Coelus* which you found so plentifully at Coronado but it is a beautiful *Eusattus,* quite new to our collection. I think it is *Eu. ciliatus,* quite recently described by Horn from Baja California—The series of Edrotes is very interesting and quite puzzling; the two smallest specimens came close to *E. rotundatus* Say from Colorado and Wyoming, while the larger specimens are intermediate between *E. ventricosus* Lec and *E. ustidus* Casey. I think the whole is only one species extremely variable in size, punctuation and nature of the pubescence—The "much larger specimens of an allied genus but more elongate" resembling also an elongate *Craniotus pubescens,* is *Asida hirsuta* Lec. new to our collection, found originally by LeConte *"in arenosis desertorum Colorado"* (in sandy places of the Colorado desert)—"Pretty little stout Tenebrionid with red legs and sparse pubusience and with aricular punctures" is

Conibius puberulus Lec., originally described by LeConte from Vallecitas, Cala (due south of Palm Springs).—The Calosoma is *C. angulatum,* Chevr. new to our collection and originally described from northern Mexico.—What you call "Asida sp. with dentate femora" is always *Eleodes armata* Lec. peculiar to the extreme Southwest.—I forgot to say that the Conibius puberulus is hardly a myrmecophilous insect though the larva of this and no doubt other species of Tenebrionidae of the arid Southwest will be found to live in ants' nests.

March 13, Palm Springs.—The small Meloid with red head is *Cantharis auriculata* described by Horn from "southern California". We had 2 specimens in our collection from the Morrison coll. labelled "Kern Co., Cala."

March 14. The very large Meloid with red head, thorax and legs is *Cantharis magister,* described by Horn from the desert regions of southern Cala. and Nevada.

Unless I have overlooked something upon a preliminary survey I think the above notes include everything not previously mentioned by me. Even the commonest specimens from the Palm Springs region are most welcome to our collection on account of the definite locality. I think you will find now various species of Meloidae and Malachiidae and other phytophagous families and please remember that our collection is quite deficient in well labeled specimens from that region.

I have made a few determinations of your lot 7c and previous sendings from Palm Springs which I hope I can write you tomorrow.

In our Department we are still in great expectation of what the next time will bring us. Mr. Brigham of Ohio has been nominated by the President as Assistant Secretary. He announces himself as a practical farmer and as entirely ignorant of scientific methods. Probably in consequence of this, the new Secretary announces that a "reorganization of the Department will take place shortly and that he himself will take charge of the scientific work of the Department. No one knows what this "reorganization" will amount to, so all we can do is to wait. At any rate my proposed Arizona trip has also to wait until that reorganization has taken effect.

I regret to inform you that old Dr. Hamilton died last month in Florida. Since a couple of years the old gentleman expected to die at any moment, still he lived to visit Florida 3 times and to enjoy the climate and the collecting of insects at Lake Worth.

Yours ever,

E. A. SCHWARZ

Washington, March 25, 1897

Dear Hubbard,

I was greatly pleased with your letter of the 18th you give good directions for future addresses and I shall now prepare lists and packages to be sent you at Tucson before the end of this month. Mr. Fernow told me before of the unpleasant sand- and dust storms that prevail during spring in parts of Arizona but I suppose that you will eventually change your headquarters if there is too much dust at Tucson. After all, spring is not much earlier with you than with us; last Sunday the weather suddenly became very warm, and flowers, leaves, bees and beetles made their appearance. To-day we have a reaction and it is now almost freezing but this cannot last very long, and if you choose to send on the Dinapate larvae I think they will not suffer from the cold. I examined with great interest the piece of palm wood you sent to the Department and realize now the enormous difficulty in the way of sawing or cutting out such a piece.

When you get back to Yuma and Tucson I suppose the country will look now quite differently from when you left it in January and the desert will swarm with horned frogs, Gila monsters and rattlesnakes but I have no doubt there will be also some insect life.

For some time I intended to make a list of the Coleoptera collected by LeConte at the lower Colorado and Gila, the species being scattered throughout his publications but I see that he recorded precise localities only during about 10 years after his expedition. Later on he had apparently forgotten the precise localities and no doubt many of his captures at Yuma and vicinity have been recorded as from Southern California or simply Arizona. Even in his earlier records it is often not clear whether he means with "Colorado" the Colorado Desert or the Colorado

River. Many of LeConte's captures were also subsequently described by Dr. Horn but I have not yet gone through all of his writings. But incomplete as it is I think you will be interested in glancing over the list I send you herewith in separate envelope. Do not throw it away as I contemplate to complete the same for future reference. It contains many species which you have found but you will see that a great many species, especially among the phytophagous families still remain to be found. However you may be too early for most of them since LeConte was at the Colorado as late as April, probably the end of the month.

I am commencing to capture Arizona beetles here in Washington, for day before yesterday there came flying into my office room a fine Arizona Clerid, *Clerus spinolae.* I presume it came from the samples of Arizona timber Fernow and Merriam have brought along last fall.

The Carpophilus on Cactus flowers is *C. pallipennis* which is also common in Florida. I wrote you a letter to Palm Springs in reply to your lot No. 7d and hope that it has reached you.

Yours ever,

E. A. SCHWARZ

Washington, D. C., March 29, 1897

Dear Hubbard,

I send you herewith two lists which may possibly interest you; one being the continuation of the fauna of Yuma and Tucson, the species being taken all from the writings of Dr. Horn. Some species are of course duplicated from the first list (LeConte's species) of the Yuma species. There remains still to be copied a list of the Yuma species from the writings of Capt. Casey but there are so many synonyms and doubtful species among them that a list would add very little to the actual knowledge of this fauna. The second list I inclose is an abstract of a large list of Arizona Coleoptera found by Wickham along the line of the Atlantic & Pacific R. R. at The Needles and at East Bridge (on the Arizona side of the Colorado Riv. opposite the station Needles) He was there in July and August but you will see that quite a number of the Yuma species extend northward to the Needles and if you were at Yuma in midsummer you would no doubt find

the genera Chalcolepidius, Gyascutus, Acmaeodera, Orsonyx, Mallodon, Aulaeoscelis, etc. On the other hand it is safe to say that if Wickham were a little more careful collector he would have found at the Needles many of the more subtile species which you found at Yuma. Of Mr. Wickham's localities only Peach Spring is (besides the Needles) within the Lower Sonoran fauna; the remaining higher localities being either in the Upper Sonoran or even the Transition Zone so that if you should visit Flagstaff or the brink of the Great Canon you must not expect to make brilliant captures. In fact the fauna at these places would remind you considerably of that of Helena and the Bear Run Mts. of Montana.

Returning to LeConte's and Horn's visit to the desert regions of northern Arizona I find it strange that neither of them have ever published a general account of their experience. Dr. Horn is very fond of narrating his experience of the trip from San Diego to Yuma during which he could not do any collecting. During the life time of Dr. LeConte I unfortunately omitted to ask him about his trip and as I mentioned he never published a general account of it but even his biographers, Scudder and Horn, only make short allusions thereto. Mons. Aug. Sallé seems to have been the only one who has questioned LeConte regarding his experience and in his biographic note of LeConte published in the Annales de la Soc. Ent. de France a few lines are devoted to this subect which I herewith copy: "Dr. LeConte revint en septembre 1851 (à New York), apres avoir explorè les environs de San-Francisco, San José, San Diego, Vallecritas, la Desert du Colorado, et reconnu, au milieu de grands périls, les rives du Rio-Colorado, depuis sa jonction avec le Gila jusqu'à la mer; ce fut le premier voyageur qui ait pu remonter le cours du Roi-Gila jusqu'au village des Pimas; il a en ses deux chevaux et ses bagages volés par les Indiens, ce qui l'obligea à faire 30 milles à pieds nus pour regaguer le camp, se nourrissant d'épis de mais vert. Une excursion qu'il fit, du Fort Yuma jusqu'à Tucson, lui donna un faible récultat entomologique, la saison n'étant pas favorable.—A son retour à New York, il publia les Ténebrionides et les Histerides, puis les Cicindélides et les Carabides de son voyage, dans les *Annals of the N. Y. Lyceum of Nat.*

Hist. vol. 5, 1851. Il n'avait rapporté avec lui que sa collection, laissant ses doubles à San-Francisco, pour l'en-être envoyés, mais ils furent détruits en juillet 1852, dans le second grand incendie qui brûla la moitié de cette ville.''

I am greatly desirous of hearing your experience at Yuma just one month after your first visit and suppose that the progress of the season as well as the absence of another freshet will produce a great change in the character of your collection.

Your brother, Mr. C. R. Hubbard is here to induce Congress to change the proposed duty on oranges or at least to postpone the date when the new duty is to be enforced. His entire Jamaica business would be utterly ruined if the new duty is to go into effect the present summer. By a very strange coincidence Miss Mowly Morton was run over by a bicycler on 14th str. the same hour your brother arrived here. It is to be hoped that nothing serious will result although she was unconscious for several hours.

Yours ever,
E. A. SCHWARZ

Washington, D. C., April 5, 1897

Dear Mrs. Slosson

I should be very glad to name for you any Florida Coleoptera which you may choose to send to me, and of course I shall return everything. I beg you, however, to pack the specimens very carefully for the other day I was greatly shocked to see in friend Coquillett's hand a box of your Diptera which had arrived in a dreadful condition.

I have always read with the greatest interest your publications on Florida insects and especially your contributions to the Lake Worth fauna because I visited the same locality in 1887 when a large portion of the great tropical hammock was still in existence and when there was still an abundance of tropical insects to be found there.

My old list of Florida Coleoptera is of course now greatly antiquated and since several years I contemplate the publication of a new edition but since the new list embraces about 3000

species, the publication is a matter of considerable magnitude and expense. I know that your annotated copy of the list must contain many valuable additions to localities as well as to species, and I should feel under great obligations to you if you would allow me to look it over. I would also be greatly interested in seeing Mr. Liebeck's determinations of your Biscayne Bay collection.

Yours very truly,
E. A. SCHWARZ

Washington, D. C. May 4 '97

Dear Hubbard,

I cannot tell you how badly I feel that I left you so long without any news and failed to answer so many letters and packages from you, but I am in a very bad shape and have fallen in a state of nervous despondency which I cannot throw off and which has been brought about by a bad inflammation of my eyes. This prevents me entirely from doing anything at night and even during day time I can use the lens only for a few minutes at a time. Of course I should be out with you by this time but in the disorganized state of our Department no one dares to apply for leave so early in the year. The trouble with me commenced the first week in April when poor Mr. Ulke lost his oldest daughter, Anita, after a few day's illness from pneumonia. At her funeral I caught a severe cold which has itself firmly settled as a very bad cough somewhere in my throat and as a most annoying inflammation of my eyes. By an unfortunate coincidence I have lost every Sunday in April; Mr. Richardson of Fredericksburg, Va. was with me for one Sunday, Mr. Wenzel of Philadelphia for another Sunday; then came Mr. L. Bruner of Nebraska who is on his way to the Argentine Republic, and lately Mr. Perkins of England came. He has explored the Hawaiian Islands for the last 5 years and was lately with Mr. Koebele in Arizona where they regretted having missed you. They spent some days collecting at Tucson (but apparently did not find much) and at Benson in search of *Amblychila baroni* Rivers which has been found there some years ago, and finally at Nogales which is described as much dryer than the Tucson region. Mr. Ulke is very

much broken down with sorrow over the loss of his daughter and comes now almost every evening to me and I have to listen for hours and hours to him.

Just now we have been thrown into deep sorrow by another catastrophe; poor Mr. Linell was found dead in bed yesterday morning! It is an extremely sad case from whatever side it may be considered, and I wonder what we shall do with his two little daughters who are left in this world without a single relative or friend and without a cent of money. For some months Linell had kept himself pretty straight and his death was due to heart failure.

I feel so nervous about all this trouble and can hardly write this letter and the bad news about yourself in your last letter make the matter by far worse. I beseech you to think only how you can improve your health; do not exert yourself in the least and if you think that a change of locality will do you good leave at once Tucson for another place; either go back to Palm Springs or run up to Prescott or in the pine regions of the plateau of Arizona where it ought to be warm by this time.

During my long silence the material sent on by you and your unanswered letters have so accumulated that I hardly know where to begin my answer. Not less than 9 cartoons with your pill-boxes half opened are on my table and only the topmost layers have been examined by me. In order not to fall back entirely I have managed last Sunday in looking over carefully the contents of your last invoice—Tacina and Catalina Mts.—and inclose the notes.

The Scolytid from Parkinsonia wood is of course undescribed. In shape and most structural characters it came near to *Micracis rudis* Lec. but is most remarkable from its sexual characters on the elytral declivity whereas in *M. rudis* and other species of this genus the sexual characters are strongly expressed in the antennae. Mr Hopkins has no experience with Micracis, or else he would have founded another class of Scolytids based on biological reasons. They are "inside borers" but not Ambrosia beetles and have in my experience no definite food-plants. A few specimens have issued from the pieces of wood you sent but there issued also a most wonderful Coleopterous enemy of the Micracis viz. a

Trogositid allied to Nemosoma, a small (3 mm.) linear thing with 4 yellow spots. I find that it is a new species of *Cylidrella* Sharp, a genus quite recently described in the *Biologia Centrali-Americana* and founded upon a single specimen found by Mr. Champion in Guatemala. Two specimens have so far been secured of your species, one of them slightly injured. This is one of the most remarakble species discovered by you.

I shall continue this letter tomorrow

Yours ever
E. A. SCHWARZ

Washington, May 7; 1897

Dear Hubbard,

On Wednesday we buried poor Mr. Linell; it was of course a very sad affair but we managed at least to give him a decent funeral. Upon coming home I found on my table a note from Dr. Maurice Richardson, who had been here attending the Medical Congress. He came to my house in the expectation of finding you here and is very anxious to hear from you. I went out in the evening in the hope of finding him but failed to do so although I waited in his hotel until after 11 o'cl. Yesterday morning your invoice from Tucson arrived but I lost again the entire evening from being occupied with Mr. Chittenden in looking over Linell's affairs. We utterly failed to discover what Linell did with the larger part of his salary and it seems that everything went to the saloon keepers. Early this morning I managed to spread out a little the contents of your box and give herewith a few hasty notes regarding the contents. I may however have overlooked the best species. As a preface I would say that, excepting the Cereus fauna, there is a radical difference between the species you send now from Tucson and those you sent in December and January. Among the Cereus species I am glad to see some additional specimens of that new Cossonus and at least one specimen of that new Eumicrus.

Match box Besides the *Hololepta yucateca* (*princeps*) I see two species of Eleodes, different from *E. armata,* the smaller one not sent before by you, but both will no doubt be described.

Pill box "Catalina Mts. Sabina Canon, April 18, *Amara californica.*" The Amara is *Discoderus robustus* Horn (found plen-

tifully by Morrison and described from his collection). Among the aquatic Hemiptera are 2 species of Notonecta not sent before by you. The Ant-lion on top of the box is a beautiful species.

Pill Box "Sta Cruz River and adjacent pools, Tucson, April 21."—*Agabus semivittatus* Lec. (mentioned in my last letter)—Hydroporus sp. (many specimens). I do not see this in our collection; it is not a remarkable species but its relatives are all boreal; possibly described by Sharp in the Biolog. Centr.-Amer. (For lower layers see below)

Pill box "Sta Cruz Riv.; shore fauna; Bembidium. Clivina etc." I regret to say that at least the upper layer has not arrived in good condition since it was not protected by soft paper. Please discard the thin *brittle* paper and return to the well-tried old news paper rubbed soft. I must also confess that the Chinese napkin paper is in my experience not so good as old newspaper, especially if you pack several layers in one box.—The lower layers of this box "April 20th, hill side" and "April 21 from willow" have not yet been uncovered by me on account of the damaged condition of the upper layer. Among the broken specimens I see a very large, pale Bembidium, not yet sent before by you and which seems to be good. You may perhaps be able to replace this species.

Pill box "Riatta, April 30th few shore things and Hydroporus"—2 specimens of *Agabus lugens* Lec. described from San Diego and Colorado River, not sent before by you; is not rare in southern Cala. The Hydroporus is a species of *Deronectes* different from the *D. striatellus* which you found so commonly at Palm Springs; it does not seem to be in our collection.—The Cryptobium is different from the *C. pimerianum* Lec. found by you at Yuma.—The *Elmis* appears to be the *similis* sent by you before from Tucson.—A remarkable Saprinus, allied to *mancus,* entirely opaque almost without mirror and striae; this must be something new.—A large *Olibrus* (many specimens) which I have not seen before.

Pill box "April 29 Larger shore things." *Brachynus* sp. apparently not different from one of your Yuma species—*Anisotarsus* (*Anisodactylus*) *agilis,* widely distributed and not rare.—*Trichobaris mucorea* Lec. described from California; not a great rarity but food-plant unknown. Did you find it on a Solanum?

Pill box "Tucson April 28" *Discoderus robustus*—"April 29–30 Cottonwood trees," 3 specimens of *Attagenus hornii* (mentioned by me in a former letter). "April 20 from canaigre," *Gastroidea* (*Gastrophysa*) *formosa* (mentioned in last letter), *Onychobaris mystica* Casey (?) (The black, opaque weevil with red beak and legs) This is very interesting. Can you prove that its larva lives in the roots or stems of the canaigre? Is this canaigre cultivated or wild? This Onychobaris is not mentioned by Toumey among his canaigre insects.—"On flowering shrub, Riatta Wash. April 20"—This is a remarkable layer and contains various species not yet sent before e.g. 2 species of Smicronyx, 1 beautiful undescribed species of *Copturus* which has been bred at our Department from roots of cultivated *Aster* sent by Toumey from Tucson; another specimen was found by me accidentally at San Diego Tex.—"April 27 on flowers of Riddelia," a very remarkable *Brachytarsus,* new to our collection and probably undescribed; a *Pristoscelis* not sent by you before; the Clerid is only *Trichodes ornatus* which we found so commonly on our various western trips.

Pill box Tucson, April 25 under cottonwood bark." *Hololepta populnea* (found by you at Tacna) Forficulid, quite different from that you found in Cereus (this is *Spongophora brunneipennis* Scudder) but identical with a species tolerably abundant in Florida.—"Sta Cruz River April 25" *Amara californica* (rather small, bronze-colored), not a great rarity; *Amara* (Leirus) very large, brown with red legs; we have this from Morrison's collection but without name.; *Blapstinus* (*Trichoton*) *sordidum, B. dilatatus* and another Blapstinus.—Lowest layer with the same inscription not yet examined since I do not like to disturb the specimens; among them I see one specimen of the very rare *Panagaeus sallei* (one specimen in our collection) (Pill box of April 21. Addendum) *Eumicrus punctatus* Casey, astonishing number of specimens; we have this from Morrison's collection; if there is anything else in this layer I fail to see it.—Lowest layer: Many of the Carabidae and Staphylindae are identical with Yuma species, I see one specimen of *Lachnophorus elegantulus* (rather small Lebiid, elytra nearly white with dark median

cloud), and a large Clambus (minute, contractile Silphid) which must be new (Note: Change the "*Clambus* n. sp." of the yuma list to *C. seminulum* Horn described from one specimen from Ft. Grant, Ariz., new to our collection and I am not aware that it has ever been found again).

I may have possibly omitted a layer or two in the above enumeration which, moreover, is only made after a very superficial glance at the species. It is evident from this collection that at least the spring fauna has made its appearance at Tucson. Mr. Perkins informed me that he and Koebele found many Carabidae and Staphylindae at the St. Cruz River near Tucson by pouring water over the banks but I have no doubt that they found the same things you send now. Mr. Perkins also told me that in May rain is expected at Tucson after which insects are said to swarm everywhere.

I return now to invoices made by you before:

Insects from holes of Kangaroo Rat (Dipodomys desertorum) and Spermophilus sp. Palm Springs, Cala., March 19–22, 1897.

This is the most interesting collection I have seen for a long time; To be sure there are only a few species and few specimens but in my opinion you have been well rewarded for the great trouble and expense incurred in their capture. I regret only one thing viz. that in your Gopher Insect paper you struck out the suggestion that in the subterranean burrows of other animals (besides *Gopherus polyphemus*) peculiar insects may be expected. The interest centers in the 3 species of Histeridae found by you; all three are *certainly* new, and two are certainly 2 new genera while the 3rd *may* also be a new genus. The species most abundantly found—with rather ill-defined red elytral spot but with distinct elytral striation—I consider for the present as a Saprinus, though it cannot be brought into any of the groups established by Horn or Marseul; nor is anything similar described in the Biolog. Centr.-Amer. The other two species—the one (unfortunately unique) with rather well defined red elytral spot and almost without any striation, and the other (represented by 4 specimens), entirely black with distinct elytral striation, have one character in common which removes them at once from any other

N. A. Histerid genus viz, they have only one tarsal claw but they are not identical with any uni-unguiculated genus of Histeridae known. Both species differ from each other so radically that they cannot possibly belong to the same genus, the unique specimen, especially, possesses a remarkable character viz. a deeply emarginate (in front) prosternum which I fail to find in any other described Histerid genus. These two Histerids of yours are structurally by far more interesting than your Chelyoxenus and you must by all means describe them in your Appendix to the Gopher insect paper.—on the Aphodius (one specimen, unfortunately without tarsi, evidently an old specimen just about to die) I cannot say much; it is not in our collection, nor do I see it in Mr. Ulke's collection; whether or not it is new can be found out by comparison with the species in Dr. Horn's collection. If it is new, the specimen is sufficiently preserved for description.—The Ptomaphagus I cannot, for the present distinguish from *Pt. californicus,* and its occurrence in holes of rats etc. is quite natural. —The Aleocharid, black, with red elytra and legs, is allied to Aleochara and apparently undescribed but we have it in our collection from Crotch's collection in southern California and also one specimen from Kern Co., Cala. (Morrison), so it must occur under other conditions, since neither Crotch nor Morrison dug up deep holes—A smaller, entirely black Homalota has been found by you also above ground at Palm Springs. (To be continued)

Yours ever,

E. A. SCHWARZ

Washington, D. C., May 18, 1897

Dear Mrs. Slosson,

Your letter of May 15th came duly to hand and the specimens arrived also safely. I am greatly obliged to you for your kind permission to retain that rare Lema which as you correctly say is a West Indian species. Regarding the new Sacium I must confess that I do not like to describe a new species from a single specimen. Several new species of this genus have lately turned up in various parts of the country and the genus should be monographed instead of rendered more difficult by the description of isolated species. I return, therefore, the specimen because I

know that it is well preserved in your collection. I made a note of it in my Florida list and whenever it is deemed advisable to describe it I shall let you know.

With the exception of the subfamily Aleocharinae, the Staphylinidae of Florida can now be determined; so do not be afraid to send them on for determination. If there are any Aleocharinae among them I shall simply return them unnamed.

I inclose a list of your species (which are herewith returned) and have also labeled the specimens in the box so that no confusion can arise.

Yours sincerely,
E. A. SCHWARZ

Washington, May 23/97

Dear Hubbard,

I was greatly relieved to receive your letters of the 12th and 13th; for although you do not write anything about your health, the mere fact that you have made a big excursion in the mountains of southeastern Arizona proves that you must feel better than when you wrote before. In one of my previous letters I intimated that from what I heard the spring at Tucson is not very pleasant on account of the dust, and if you can find in Mr. Lange a suitable man to accompany you in the mountains on a camping expedition, I feel confident it will do you good to spend some weeks in the dry mountain climate of Arizona before coming home. At any rate do not come home before the real summer has commenced in the north; even here at Washington the weather is still abominable and two or three days of very hot weather alternate with spells of disagreeable cold weather so that the Delaware peach crop has already several times been ''utterly ruined'' by late frosts and my cough does not improve.

Poor Mr. Ulke has somewhat calmed down but continues to come to me in the evening and reads to me the biography of his daughter. Your consolations would do him very little good; in his selfish nature he does not realize that he is not better than other people. He is now on the point of leaving for his summer home in the Blue Ridge Mts. near Pen Mar and I had to promise to visit him early next month.

Linell's affairs have been straightened up, which was not a difficult job, and a little money has been raised for his children. His landlady, Mrs. Reed, turns out to be a brave woman and will take care of the girls at present. During the last week of his life Mr. Linell commenced to draw up descriptions of new Heteromerous Coleoptera in the collection of the U. S. Nat. Museum. Since he had only a few new species I gave him for description specimens of the new Tenebrionidae found by you in Arizona and on the day before he died he drew up the description of that new Platydema (*P. inquilinum*) from the Neotoma nests at Tucson. The description was not quite finished and when I looked over the paper as he left it on his desk but I added the missing words, and we will publish this fragment of posthumous paper in the Proceedings of the Ent. Soc. of Wash.

Now, before falling back again in the reply to your letters I shall at once proceed to your letter of May 12th; As a preface I would say that owing to the inflammation of my eyes only a small fraction of the smaller specimens have been mounted so far but I have pinned all the larger specimens and looked over every layer in the pill boxes. The most formidable-looking layer of small things, the many Scolytids etc. of May 10th among the pines of the Chivicahua Mts. I mounted yesterday (Sunday) with considerable difficulty but this layer was of greatest interest. I must further say that the hilly and mountainous parts of Cochise Co., Ariz., are of the greatest interest to the student of N. A. insects from the fact that Morrison probably collected there. All of Morrison's insects are without definite locality, in fact, it is not known whether they were collected in Arizona or Sonora. His post office address during his stay in Arizona was old Ft. Grant, but his most characteristic species, e.g., the many large and striking Lampyridae have never been found again either in Arizona or in Sonora. He remained in the field till October leaving Washington in May, and it is possible that his species are summer species which are not to be seen at any other season. Wickham was in midsummer at Tucson and in the Pinal Mts. but did not find any of Morrison's species except those of wide distribution in the southern part of Arizona.

May 11th, Sulphur Springs Valley: The Eleodes are 3 species (not yet determined) quite different from any of those you found at Tucson or Yuma; the *Eusattus* is also different but is described from Morrison's material by Champion in the Biol. Centr.-Amer. (I have the name of the species not at hand).—The "medium black and quite opaque Platynus" in the soil under leaves of *Cucurbita foetidissina* is not in our collection; if described by LeConte it must be *P. carbo*.—The "related species of bright brassy green" (one specimen) is for the present quite unknown to me and likewise not in our collection.—The "large Harpalus?" (3 specimens, all badly mutilated) is *Polpochile capitata* Lec. peculiar to Arizona and a genus new to our collection. I hope you will be able to unearth a few perfect specimens. It is readily recognizable by its large size, large head, very transverse thorax *without* hind angles—"Dark bronze Amara," different from *A. californica* and belonging to the Celia group.—"Chlaenius," only a fragment which indicates a good species.—"Black Casnonia"; this is *C. picta* Chaudoir described from Mexico, and new to the fauna of the U. S. and to our collection but I am inclined to think that it is only a race of the widely distributed *C. pennsylvanica*.—"Doryphora on *Solanum eleguifolicum* is *D. defecta* Stål which I found in southwestern Texas on the same plant; it is well distinguished from D. 10-lineata—"Small Agonoderus," this looks quite common and may be the widely distributed *A. pauperculus*.—"Pterostichus"; this is an Amara of the subgenus Lirus, apparently different from the species you found lately at Tucson and Tavna. "Anisodactylus"; this is a Cratacanthus considered by Horn as a race of our common *C. dubius*—"Aleocharid probably Myrmedonia"; these belong to the genus *Apocellus* of the subfamily *Oxytelinae* and the same, or closely allied species were found by you at Tucson and Palm Springs. All these southwestern forms were considered by LeConte as belonging to the widely distributed *Apocellus sphaericollis* Say but Casey has lately split it into 4 species, and Dr. Sharp has done the same with the Mexican forms of *A. spaericollis*. The ♂♂ have appendages on the penultimate ventral abdominal segments and the species have been made upon the variations of this character. Otherwise they belong all to a single species.

Regarding the Oak fauna of the Mts. of Arizona (May 9) do not forget that Cockerell has described a Brachyscelid gall from this region and that Ashmead is very desirous of having the Cynipidous galls.—Your "Rhynchites with blue elytra and red thorax" is a most beautiful species of the genus Eugnamptus which I never saw before; it is certainly new to our fauna but may be described from Mexico.—The "elongate blue Chrysomelid like a Chaetocnema" is *Luperus* (now *Luperodes*) *Morrisonii* Horn, new to our collection and peculiar to Arizona. Are you sure that this has the power of leaping? It belongs to the Galerucinae and not to the Halticinae.—The "Omalium from the regions of the pines" (Pine Canon, May 9th) is most closely allied to the species you found in *Cereus giganteus* at Tucson but certainly specifically distinct.—The insects you found at this altitude and still higher up (May 10th) are of intense interest. They represent partly species widely distributed throughout the boreal region, partly species which are only known from the boreal regions of the Rocky Mts. or from the boreal regions of the Sierra Nevada, or species peculiar to the boreal regions of the mountains of the extreme southwest. The last are of course the most interesting species and I am delighted to see among your material many of them; although for the present I can name only a few of them. "Very large red Cryptobium" appears to be *C. arizonense* Horn; the Philonth not yet investigated; Stenus, 2 or 3 species, not remarkable, quite different from those from Yuma and Tucson. "Black rather opaque Platynus" is *Calathus dubius* which occurs also in the mountains of Colorado, etc. The Gyrinus is the Californian *G. plicifer.* The "very large black and very polished Laccophilus is *Rhantus atricolor,* known only from Mexico and Arizona (we have 2 specimens collected by Morrison). The small shining Hydroporus is *H. vilis* which is not rare in the Rocky Mt. region; the larger, more opaque species is *Deronectes striatellus* found by you so commonly at Palm Springs. The Hydrophilid "like Cercyon" is *Hydrobius* (*Creniphilus*) *infuscatus* Mots. which occurs throughout the boreal regions of the West. The Hydraena is again the widely distributed *H. pennsylvanica.* Among the numerous species from May 9th not referred to in your letter I will

mention a very large and black *Lithocharis,* 3 species, which I never saw before, and a very fine, rather small Podabrus, black with red head and thorax, which is new to our collection and apparently undescribed. Here comes also again *Platynus bicolor* which you found so commonly at Palm Springs.

May 10th. This was a grand collecting day for you; the number and quality of the species being extraordinary but an enumeration not yet possible. Those mentioned in your letter are as follows: "Very large Anthophagus with read elytra the tips of which are fuscous." This is *Deleaster concolor* Lec. of the subfamily Oxytelinae (allied to Trogophloeus) a rare species known from Colorado and Utah but we never found it before.—"dark-brown almost black Lesteva." This is an *Orobanus,* probably undescribed. The occurrence of this genus (which we found so plentifully on our western trips) in the mountains of southern Arizona is very interesting.—The Philonthi, Tachinus and other Staphylindae have not yet been investigated they have as you state a decided northern adspect.—The enormous lot from freshly cut pines contains numerous rarities and novelties: "large Dendroctonus." This I cannot find but is no doubt the widely distributed *D. terebrans.*—"Three different clerids (Thanasimus)," I find 4 species which increase in quality with the decrease in size. The "largest half an inch long is *Clerus sphegeus;* the next in size, *Clerus nigriventris,* both are not rare in the mountainous regions of the West; the third species (not referred to in your letter) is smaller, more depressed than *nigriventris* with less conspicuous and differently arranged whitish fasciae; I have for the present no name for it, the 4th species "quite inert very depressed and nearly black with fine white specks" is something brand new. I think it belongs to the genus Trogodendron but nothing like it has been described from the U. S. or Mexico. There are fortunately 4 specimens of this beautiful thing. The large reddish Anthonomus with two humps "looks indeed very much like the apple Curculio (A. 4-gibbus) but is specifically distinct and probably new unless it be a giant specimen of the western *A.* (Tachypterus) *consors* Dietz.—There is also a smaller reddish Anthonomus (not referred to in your letter) which looks very good. Of Ptinidae I see two species of

Ernobius both new to our collection, one very large, the other extremely small and looking like a Hemiptychus.—The "large and handsome Graphisurus" is *Acanthocinus obliquus* which you found at Assiniboine and Lake Tahoe but the Arizona specimen is much larger.—"Small elegant Cerambycid, hairy and with red thorax (Batyle?)," this is great rarity, it is *Phymatodes maculicollis* Lec. the type of which was found by us on Isle Royale, L. S. Only a few specimens have since been found in Colorado.—Of Scolytids I find 5 species (not counting in the Dendroctonus) two of which are new to our collection and probably undescribed: *Tomicus confusus* (or allied species), 2 specimens. Other species of this genus are sure to be common in your mountains but probably all are described. *Pityophthorus nitidulus* (this is your "Guathotrichus the ♂ having a long brush of yellow hair on the head), more than 130 specimens; this occurs all over the West wherever pines grow but not in the Lake Superior region.—*Pityophthorus* sp., very few specimens, smaller than the preceding, elytra feebly punctate in striae, the ♂ without long yellow brush on the head. This was found abundantly by Koebele in the mountains adjacent to the Death Valley; it may be among the species described by LeConte.—*Pityophthorus* n. sp. only a few specimens; nearly twice as large as *P. nitidulus,* much smoother at the elytral declivity, the ♂ with a *short* brush of yellowish-gray pubescence on the head. This is a very fine species.—*Dryocoetes* (?) n. sp., only 2 specimens, as large as the preceding, elytra rather coarsely *irregularly* punctate and with *erect* sparse pubescence. This is a beautiful species of which I hope you will get more specimens if you come again among the pine trees.—Of species not referred to in your letter I mention two species of *Lasconotus* (Colydiidae, enemies of Scolytids) both represented by uniques and perhaps both new to us. They look very much like a narrow *Ditoma* with a peculiar thoracic impression.—I forgot to mention the Pselaphid among ants (Cremastogaster). This is *Fustiger californicus* Brend.(?) of which we have one specimen from Williams, Ariz., collected by Wickham.—The Bembidium represent 4 species, the largest being *B. mexicanum,* the smallest (a uniformly bronzed species) being represented by a single specimen.—The *Cryptohypnus* is

unfortunately *C. pectoralis* (pale form) which we found so abundantly in the canons of Utah.

I shall continue this letter tomorrow

Yours ever,
E. A. SCHWARZ

Washington, D. C. June 1/97

Dear Hubbard,

In spite of all exertions I am falling back more and more in the working up of your material and in the reply to your letters. Yesterday being a holiday and the preceding Sunday I worked hard but succeeded only in mounting all of your Chiricahua Mts. material and some of your last sendings from Tucson. In the meantime your letters of May 18th and May 19th arrived and this morning your great letter of the 25th (with appendix dated May 27th) and two big boxes came. In the office I opened your box addressed to Dr. Howard (who is at present gone to Massachusetts looking after the Gypsy Moth or rather after the Gypsy Moth Committee who managed to introduce accidentally another European Bombycid moth, *Porthesia chrysorrhoca* which is much more dangerous than the Gypsy Moth) and Pergande studied the Lecanium and myself the Coccinellid. The Lecanium is *Toumeyella mirabilis* described by Cockerell from Tucson on Mesquite. Pergande says, the genus is a good one although it has not been properly described by Cockerell. The Coccinellid I had never seen before but I determined it with certainty as *Thalassa montezumae* Mulsant. I was extremely glad to see a representative of this genus which is very closely allied to Brachyacantha and Hyperaspis. The species is described from Mexico and is recorded in the Biolog. Centrali-Americ. from many localities as far south as Guatemala but Mr. Gorham states that it seems to be rare everywhere. It has never been found in Arizona and the only specimens known from our fauna come from San Jose del Cabo in Baja California. It constitutes a new genus for our collection. Its wide distribution does not indicate unity in food-habits; still it is possible that it is confined to Lecanium and that its introduction into California would add an important enemy to the Black Scale. Such importation appears to me quite feasable but there

is at present no one in southern California to whom the management of the Coccinellid could be entrusted. The larvae, pupae and imagoes of the Thalassa you send are thickly covered with Lecanian larvae and there is imminent danger that the intended introduction of the Thalassa would result in the introduction of the Toumeyella. Koebele is now in Mexico collecting Scale-feeding Coccinellidae for transportation to Honolulu and is not expected to return to Alameda before the fall. You may send the Thalassa to Cockerell but he is quite ignorant with the methods of colonizing an insect and may possibly allow the Scale to run away at his place. The larva of the Thalassa very closely resembles that of *Brachyacantha ursina* which are kept as cattle by the ants. Several predaceous Lepidopterous larvae were among the Toumeyella sent to the Department.

Before answering your letter I must record some breedings of larvae sent by you: From the Sunflower and Cocklebur stems sent by you from Tucson last December the Cerambycidous borer has finally been bred. It is unfortunately the common *Ataxia crypta* which lives in old cotton stalks and all sorts of drying up branches all over the South. I think I wrote you before that from the same sunflower stems the little *Copturus adspersus* has issued.—The Tenebrionid from nests of *Neotoma albigula* has finally been bred—*Nycobates subnitens,* as predicted. You never found the imago alive and only sent a dead specimen (but in good condition) found among the debris of the nests. The larvae refused to eat here anything but paper but devoured one label after another and were exceedingly fond of blotting paper slightly moistened with water—The Cossus larva you sent from Palm Springs to the Department has also been bred after having done a great deal of damage by boring through several thick boxes. You sent it in a box containing some moths and other material, all of which this savage larva had devoured. The imago no one knows but it is identical with the imagos you sent on lately from Tucson and which you found flying at night.—The Pyralid from the spines of Koeberlinia from Tucson has also been bred but nobody here can name it.—To-day while looking at the pieces of Parkinsonia wood bored by the new Micracis I beat out a beautiful small Clerid beetle, entirely unknown to me and quite new to our collection.

Since many days nothing has come out from this wood and I shall now proceed and cut the pieces up in the hope of finding more specimens of this Clerid and of that Cylidrella (Trogositid).—From the mesquite twigs you sent from Tucson last December nothing has so far been bred but I know now that they contain 2 Cerambycid larvae which once a while make their appearance having eaten their way entirely through the twig. I always put them in again at the other end of the twig but it is extremely doubtful whether the imago can be bred.—The Larrea twigs sent from the same locality and same date remained silent until quite lately when something commenced to throw out heaps of sawdust; it is apparently also a Cerambycid and there is some chance of breeding the imago.—The Bostrychid from the stems of Allenrolfia from Salton has not yet been bred but there is evidence that the larvae are still alive. I am afraid the imago will turn out one of the common Synoxylon peculiar to the southwest and which you would find commonly as imagos later in the season.

While speaking of bred specimens I cannot refrain from mentiooing here two other species. First your Lampyrid from *Cereus giganteus,* bred May 7th. I had noticed the larva sent by you with the Cereus material but it did not appear to be something extraordinary. The imago bred by you is however a beauty, a Lygistopterus which I never saw before and which is no doubt undescribed. It is not described from Mexico. Your second discovery in Cereus, viz. the presence of the broken Colydiids in the Cactophagus cells is most extraordinary and I fail to find an explanation of this phenomenon. I opened one of the cells you sent and sure enough there were the battered Colydiids in great number. The strangest thing in this connection is that you never found this Colydiid elsewhere. It is a Bothrideres and a new species. Not a single specimen is entire but the species can be described from the fragments. If you come across the old cells of Scyphophorus in Yucca or Dasylirion do not fail to investigate them for this Colydiid. Our eastern *Bothrideres geminatus* is quite abundant under bark of various trees and its larva is probably predaceous.

I have opened the boxes of your Galiuro Mts. collection but only took a glimpse at the topmost layers so that I have not yet

seen most of the species mentioned in your letter. However I saw enough to satisfy myself that your Dasylirion fauna is of the greatest interest and contains *many* astonishing species. First of all it is very interesting that you found in the Dasylirion a large proportion of the Cereus fauna; the Hololepta is however different; it is *H. vicina* Lec. described from San Diego, Cala.; habits never recorded. The Trogosita-like beetle is for the present entirely unknown to me, even as to its family relation!! It is certainly a most interesting addition to our fauna whatever genus it may turn out to be. I have to mount a specimen before I can investigate it.—"The commonest Staphylinid apparently allied to Siagonium" is a veritable beauty indeed. It belongs to the genus *Piestus* which abounds in species in central and South America and the particular species of *P. extimus.* Sharp described in the Biolog. Centr.-Amer. from Chihuahua. In 1895 Dr. Horn (in his 1st addition to the Coleopt. Fauna of Baja California) called attention to the existence of this species in Arizona, having received one specimen from Mr. Ricksecker. No precise locality was hitherto known.—The *Eleusis fasciata* I have not yet seen but I find it remarkable that this true bark-beetle should occur in Dasylirion.—"Small Staphylinid related to Stilicus"; This is also a beauty which I never saw before; it is an Echiaster (=Lena Casey) of which another, entirely pale species is not rare with us under old leaves. Your species is no doubt undescribed. The "Tenebrionids, small quadrate forms" and the *Araeoschizus* (2 species)" I have not yet seen but your "1 ex. of an interesting Ptinid, hairy and red in color, apparently related to Hemiptychus" is another first class rarity. It is pretty certainly *Rhadalus testaceus* of the Melyridae (*Malachiidae*); peculiar to Arizona, a genus new to our collection; nothing recorded of its habits. —The *Apotrepus* does not seem to differ from *A. densicollis* you found so plentifully in Cereus.—The yellow Luperus on Nolena is apparently *Triarius trivittatus* Horn (the genus has quite recently been erected by Horn, allied to Luperus) described from the Pinal Mts., Ariz.—"Lamellicorus larvae in central axis of dead Dasylirion." Whatever this may turn out to be I do not know yet but at least some of the larvae you sent from the Sta. Rita Mts. are still alive, and Pergande feels sure of being able to

breed the imago. In fact, one larva seems to have changed to pupa. Pergande had great trouble in providing food for these larvae but finally he found that they accepted the old Yucca flower stems which grow in the Department grounds. Of two larvae put in the same stem one was killed by the other which bored its way straight through the body of its companion.—The Cerambycid of the size of *Oeme rigida*, light yellow, smooth and with faint lines on elytra" is no doubt *Gaminus vittatus* (although I have not yet seen the specimen), peculiar to Arizona; habits unknown, we have a specimen from Morrison's collection. —The large Psyllid from Celtis is a species of *Pachypsylla* which I know from specimens collected by Morrison. The galls you send are closely allied to our eastern *P. venusta*; the imagos are a little different but probably only races of the same species.—The "riparian fauna" has not yet been investigated by me and I cannot tell, therefore, if it contains something peculiar. The large rather pale Bembidium is the same you found at Tucson.—The Cicindela is not one of the common forms; it is *C. tenuisignata* Lec. peculiar to the southwest; I found it also at Laredo, Tex., along the Rio Grande.—"Large pubescent etc. Dorytomus" is *D. brevisetosus* Casey, described from Arizona; that this species develops in the Polyporus fungus is very interesting, because the allied species have been bred from the calkins of Cottonwood. (It may have only harbored in the old fungus, which was in a hollow cottonwood.)—"4 or 5 specimens of very strange little Carabid, pale yellow, size of an Agonoderus etc."; I have not yet uncovered this layer but the species is unquestionable the rare *Pachyteles testaceus*, described by Dr. Horn from specimens found at Fort Grant; it is a genus new to our collection.

The rest of your collection is for the present still invisible to me but tomorrow I shall go to work and soften the upper layers so that I can at least see what is in the lower layers. The mounting of all this immense material will take considerable time since with my inflamed eyes I make but poor progress. I have, however, mounted your entire Chiricahua Mts. collection and also the layer of Staphylinidae marked Pine Cañon, May 10th. This contains an astonishing number of species, only one of which, *Actobius* (*Philonthus*) *paederinus* (red and blue) is identical with the fauna of Yuma and Tucson. Some of these species will be boreal

species of more general distribution but I see at least several species which are no doubt peculiar to these southern mountains. The most remarkable among them is a rather small brownish, opaque *Aloscharid* (?) with very long, fine and setose antennae and with the sides of the thorax explanate. There are 2 specimens of this rarity, the like of which I have never seen. The large black Philonthus, a very common looking species, seems to be also something good, for I failed to see it in our collection. If you visit this cañon again do not fail to try again sifting near the water.

The news about your health could be better and I am especially sorry to learn that you took again that beastly medizine, calomel from which you had to suffer always. Do not work too hard and above all do not go north too early. Just now it is snowing in the north and it is very cold and chilly here.

I enclose a full abstract, almost a copy, of Wickham's little paper on his excursion through the Pinal Mts. which may possibly interest you. You will see that he either found very few species or failed to mention his best captures.

When J. B. Smith was here he told me that he made a photograph of the Washingtonias at Palm Springs. As I never saw a picture of this palm tree I asked Smith to give me this photo which he did and I enclose it herewith. You will see therefrom that Smith—and no doubt many other travellers—mistake the Yuccas at the depot of Palm Springs for the palms!

I wrote you a letter to Willcox, and I am quite astonished to see that you did not receive it when you mailed your last letter. I also sent two boxes of vials, and a box of cigars and forwarded several letters. I also mail with this a package with empty slide boxes.

Take care of yourself.

Yours ever
E. A. SCHWARZ

Washington, D. C.
June 3, 1897

Dear Hubbard,

In my account of specimens bred from material sent by you I forgot to mention that from the Alleurolfia stems from Salton

quite a large Dipterous larva (a Tachinid??) made its way out of the stems. We put it in a jar containing pure salt in which the larva at once buried itself and where it seems to feel at home. It is still alive and has shed one skin. From your various sendings of Srew beans nothing new has issued, the set from Yuma furnishing *Bruchus prosopis* and that new Bruchus, that from Palm Springs *Bruchus prosopis* and *B. desertorum.* The numerous hymenopt. parasites are the same in all sets.

Yesterday evening I commenced to mount the Dasylirion material and although I did not come very far it is plain that this fauna is quite different from that of *Cereus giganteus* and is somewhat related to the fauna of the Cottonwood bark, omitting of course the species peculiar to Dasylirion. The *Belonuchus* is quite different from *B. ephiphiatus* and may be the true *B. xanthomelas.* Of the *Paromalus,* the one with nearly complete elytral striation is *Epierus planulus* Er. (described from Mexico) which you found under cottonwood bark at El Rio and Tacna (it was found by LeConte at Yuma); the other species without elytral striae is *Paromalus tenellus* found by you with the preceding. It is new to our collection and was found by LeConte under bark on the Colorado. The medium-sized Aleocharid with bright red elytra is to my surprise identical with the species you found in rats' nests at Palm Springs about which I wrote you before. I remember now that it is the species to which Crotch gave the MS. name *Homalota cacti* (found by him in southern Cala.—A very small black Homalota, not at all remarkable but not found by you before.—The Eumicrus may be identical with the Cereus species, and so are the *Ulosonia marginata* and the little Ditoma (this seems to be undescribed) but the three last named species are not peculiar to Cereus and were found by you plentifully under Cottonwood bark. About the Hololepta I wrote you before. The *Hyporhagus* may be *H. opuntiae* though with your large series sent on before I got a little mixed up in regard the specific limits of these species.—What the other Dasylirion species in your boxes will turn out to be I do not know yet.—I have mounted and investigated several specimens of that brown Trogosita-like species and find that it belongs to the Heteromera. In fact it is an *Othnius* and quite different

from any hitherto described from the U. S. or Mexico. The species of this genus are still extremely rare in collections and nothing is known of their food habits or earlier stages. You will remember that you found 2 specimens of *Othnius umbrosus* at Hood River, Or., on the pile of oak wood near the hotel.—The Rhadalus was correctly recognized by me; it is also an extremely rare insect and nothing is known of its habits.

I am in trouble about printing locality labels for your specimens found since leaving Tucson. My little map of Arizona is too imperfect to follow your expedition and while for the specimens of May 9th and 10th the label "Chiric Mts" will probably suffice I do not know how to label the specimens from May 11th (Sulphur Spring Valley) nor those of your last expedition to the base of the Galiuro Mts. Please prepare me for printing the localities; also tell me whether I have to print "Sabina Cañon." The fauna of that locality seems to differ considerably from that of Tucson.

Two specimens of a little Hemiptychus, not a remarkable species, issued to-day from the old Psyllid galls on Celtis which you sent on.

Regarding the *Thalassa montezumae* I will add that Crotch records a specimen said to come from New Orleans; the locality is no doubt incorrect or the specimen was accidentally introduced from Mexico. The pupa of this Coccinellid is very remarkable and closely imitates the Lecanium (Toumeyella) scale.

Yours ever
E. A. SCHWARZ

Washington, D. C.
June 4, 1897

Dear Hubbard,

I forward herewith a letter just received and add a few words on the progress of the mounting of the Dasylirion insects. I finished yesterday evening the small pill box of May 24th. The Trimium (one specimen) is *T. puncticolle* which you found also in Cereus; the Holoparamecus does not differ from those in Cereus and those from Palm Springs. Besides the very small Homalota mentioned in my last letter, there were 3 other Aleo-

charids: 2 Homalotas, not remarkable, one being closely allied to but specifically different from the Cereus species; the other, very common looking has been found by you at Palm Springs. The 4th very minute Aleocharid is an *Oligota* (one specimen) not found by you before. At the bottom of the box were the few species that came to light on the same day. Among them is a rather inconspicuous but most remarkable species (one specimen) which I take to be a Lampyrid allied to Phengodes. It is about 7 mm. long, narrow, dirty testaceous, with very short, pointed elytra, the hind wings not folded and covering the long abdomen. There is nothing similar described from our fauna but some apparently allied genera are described by Gorham from Mexico who places them in the Lymexylidae. If your species is allied to Phengodes it has probably a luminous larviform female. The other species of the same layer are: *Gaminus vittatus* (cerambycid), quite rare in collection, known only from Mexico and Arizona, only one specimen (coll. Morrison) in our collection; *Notoxus calcaratus,* found by you commonly at Tucson, Yuma, Palm Springs, etc.; *Monoxia guttulata* (Chrysomelid) found by you at Yuma and Palm Springs; *Bembidium flavopictum,* extremely *abundant* at Tucson, Yuma, etc; *Bradycellus rupestris* found by you at Tucson, Palm Springs, etc.

Another wonderful thing (not referred to in your letter) has been found by you at Tucson, May 6, "came to light in bedroom." There are only two specimens in this layer, one the Dermestid *Attagenus hornii* which does not seem to be rare in Arizona. This is no doubt the parent of the blackish larva with long black anal pencil of hairs, the skin of which has been sent on by you at several occasions and also among the Cereus material. The second specimen is the remarkable one: it is slightly shorter than the Attagenus, oval in outline, brown, pubescent, antennae and legs about as in Epuraea, the thorax with 8 longitudinal costae, elytra strongly punctate-striate with the interstices subcostulate. I have never seen anything like it, and at present I take it to be a new genus of Colydiidae allied to Synchita.

Yours ever,

E. A. SCHWARZ.

Washington, D. C. June 7, 1897

Dear Hubbard,

I forward herewith another letter and add a few more notes on the mounting of your last invoice. Yesterday being Sunday I did a great deal of mounting but struck some layers containing many small things so that progress was very slow.

The "Pill box of May 20th," Foothills of Winchester Mt." contains some wonderful things. There is first that beautiful Carabid, *Pachyteles testaceus,* an extremely rare thing and a genus new to our collection. It was described by Dr. Horn from a few specimens he found in company of *Panagaeus sallei* at Ft. Grant. A second, much larger species of Pachyteles, *P. parca* has been described by LeConte from an unknown locality in Arizona.—In the same box I found to my delight a second, much brighter colored specimen of the Lampyrid allied to Phengodes which I mentioned in my last letter. I looked somewhat close at the specimen and for the first time I saw the marvellous formation of the palpi; both the labial and maxillary palpi have the last joint enormously prolonged so that they appear as black threads lying upon the breast. From this structure I recognized the insect at once as belonging to Horn's genus *Telegeusis* described by him last year from a single specimen from the Sierra San Lazaro in the Cape Region of Baja California. Horn places this genus in the tribe Drilini of the Lampyridae which tribe is known only in a few genera from Europe in which the ♀ is almost as larviform as in Phengodini. The ♀ of Drilus has been found only feeding on snails. Your species is no doubt identical with that described by Dr. Horn.—In the small box there were also two specimens of a true Phengodid, viz. *Mastinocerus opaculus* Horn, described with the preceding species from one specimen from Arizona (precise locality unknown). It is about the size and nearly the color as the Telegeusis but at once known by its flabellate antennae. It is new to our collection though we have plenty of specimens of *Mastinocerus texanus* which may also occur in Arizona since Horn has it from Baja Cala. The female of Mastinocerus is still unknown but is doubtless larviform and brightly luminous. You may possibly find it at night in your camps.—There is further in the same box one

specimen of a Silphid genus new to our collection viz. *Echinocoleus setiger* Horn described from two specimens from Arizona (no precise locality known). It is a broadly oval, small, brownish *Catopid* closely resembling in outline our *Ptomaphagus* (Catopomorphus) *brachyderus* which was one of the greatest rareties we found in Michigan. I had never seen the Echinocoleus before and am not aware that other specimens exist in collections besides the two type specimens. The same box contained further a very nice little Lathrobium (1 specimen) not sent by you before, a good-looking Melanotus (two specimens); an Apocallus (the Myrmedonia-like reddish Staphylinid) different from the species from the Chiracahua Mts. Your Cossonus from willow is a Rhyncolus differing from any in our collection. The Psylla from Celtis is a Pachypsylla but probably not the author of the galls you sent.—The Capsid from Yucca leaves is known to me from Texas. It has a name, and Townsend has published a note on it from New Mexico.—The Capsid from Agave Palmeri is unknown to me.—Among the Dasylirion material, box May 23, I was pleased to find many duplicate specimens of the small species mentioned by me. Among the Histerid there is a third species viz. *Epierus nasutus,* described from Arizona. It is most closely allied to *E. planulus* but has a little horn on the clypeus and a little different elytral striation.—A Hesperobaenus or Nomophloeus), 2 specimens, entirely red, not found by you before and probably undescribed.—A beautiful *Lithocharis* (1 specimen) large, deep black, which I never saw before; it is allied to the species you found May 10th on the Chiricahua Mts.—A small, insignificant-looking Leptacinus (allied to Xantholinus), two specimens, may turn out to be a new species. The square-bodiced, medium-sized Tenebrionid, black, with red legs and antennae, opaque, elytra without striae is a very good-looking Conibius, not in our collection and not described in Horn's Synopsis; it may however have been described by Casey.—The *Cremastochilus* in the same box is *C. saucius* Lec., described from Arizona (Ft. Whipple), only one specimen in our collection (Morrison). I suppose there is no connection between this species and the Dasylirion.—Among your large weevils from Dasylirion there are only two specimens

of Yuccaborus, the next being Scyphophorus. Should you find old pupa cells of the latter try and find in them that new Bothrideres (Colydiid) which you found at Tucson in Cactophagus cells.

Yours ever,
E. A. SCHWARZ

Tucson, Ar.,
June 25, '98.

Dr. L. O. Howard,
U. S. Entomologist.

Dear Sir,

I managed to-day to prepare for shipment three cigar boxes filled with pinned insects, mostly lepidoptera collected partly at Catalina Springs (foothills of Sta. Catalina Mts.) and partly in Madera cañon, St. Rita Mts. of this Territory. Regarding the specimens I hope that at least a portion of them will be new or acceptable to the U. S. Nat. Mus. collection. The system of labeling has been explained in one of my last letters but regarding the packing material I must add a few words. Having forgotten to take sheet cork with me I borrowed from Prof. Toumey one dozen sheets of cork (2nd quality) which I beg you to return to him as soon as convenient since he intends to leave for California within the next two weeks. Further, I used, with great success, my old San Antonio overcoat for packing the boxes, and I would beg you not to have the coat sent over to my house. The entire package goes from here by express, *unpaid.* I hope the specimens will arrive in good condition; a portion of those captured by me at Madera cañon are still here but I will ship them from the Oracle where we go next Monday.

I also shall mail you to-day (if possible, or at any rate tomorrow a small package, (marked no. 12) containing two pieces of a mesquite branch covered with a scale which neither Mr. Hubbard nor myself saw before. They occurred on a clump of trees in the large mesquite forest which in former years covered the entire Sta Cruz valley south of Tucson but of which only fragments have escaped the general destruction by man. All trees affected by the scale were dead or dying and the scales

themselves seem to be all dead. The particular locality is about 10 miles south of Tucson.

Respectfully,
E. A. SCHWARZ

Crescent City, Fla.
Dec. 19/98

Dear Dr. Howard,

I arrived here yesterday and expect to leave again tomorrow for Washington. Henry Hubbard is still alive but in the most pityable condition. The end may come at any hour or it may be deferred for a couple of weeks. He suffers fearfully but bears up manfully. He was greatly pleased to see me once more.

Mr. C. B. Hubbard and two of his sisters as well as Mrs. H. G. Hubbard and her mother are here so there is plenty of attendance.

Yours sincerely,
E. A. SCHWARZ

Detroit, Mich.
January 21, 1899

Dear Dr. Howard,

When Hubbard died at Crescent City there were only his wife and her mother present and as there were thousands of things to be attended to I could make myself quite useful. We left with the body on the same day northward, had in Jacksonville quite a time with the State health authorities and in Cincinnati another day regarding the transfer of the body. But we managed to reach Detroit early this morning. The funeral will take place tomorrow afternoon and you may expect to see me return on Tuesday morning.

There was universal mourning at Crescent City, and many hundreds of white and black people lined the road through the pinewoods when we carried Hubbard's body to the railroad station. I am quite tired out.

Yours ever,
E. A. SCHWARZ

Washington, D. C., Febr. 20/99

My dear Mr. Fall,

It is true that I have badly treated you of late years and I hardly know how you can pardon me for this neglect. The fact is that during the past two years I have been and am still badly sick, and further all my thoughts were concentrated in the welfare of my old friend Mr. H. G. Hubbard who since the fall of 1896 has been suffering from tuberculosis. In spite of all care and attention given to him he has succumbed last month to this terrible disease, and his loss bears heavily upon me. With the death of LeConte, Horn, Hamilton, Linell and Hubbard I feel very lonesome and shall hardly be able to pick up my old enthusiasm for Coleopterology.

Dr. L. O. Howard has just shown me your letter of Feb. 2nd in which you ask for the loan of the Nat. Museum material in Lathridiidae. I am extremely glad that you intend to work up this family and Dr. Howard will no doubt let you have all we possess. The old Museum collection contains hardly anything of interest in this family excepting the material collected by Koebele in the Pacific States. The collection Hubbard & Schwarz belongs now to the Museum but is not to be incorporated as long as I live. It is probably richer in N. A. Lathridiids than any other collection and the specimens are certainly more carefully labelled than elsewhere. But now comes the trouble! The pinning and packing of all these subtile things involves an enormous outlay of time and work, and this is the only thing which I hate to do in this matter. However I am gladly willing to undertake the job; please let me know at what time you want the material. The Lathrididae of the Hubbard & Schwarz collection fill 3 Smith boxes.

Can you furnish me, as a loan or in exchange, a specimen of the Scolytid *Chaetaphloeus hystrix?* Hubbard & and myself we have turned up, mostly in Arizona, 8 or 9 species of this genus but none seems to agree with LeConte's description of *C. hystrix.*

What has become of your Monograph of Apion? In 1897 and 1898 Hubbard & Schwarz made a good collection of Apion in

Arizona and have most of our species connected with their food plants. Do you want to see them?

Yours sincerely,
E. A. SCHWARZ

Washington, D. C. Feb. 27/99

My dear Mr. Fall,

Mr. Ashmead has commenced the pinning and packing of the Lathridiids of the old Museum collection. Those of the Hubbard & Schwarz collection I intend to pin and pack myself but I regret to state that my right arm is still paralyzed and that for the present I am unable to handle the pinning forceps.

At the Department of Agriculture there are some European Lathridiidae determined by Mr. E. Reitter; do you desire to see them? Do you include *Monoedus* in the Lathridiidae? I see that Dr. Sharp has made a new family of this genus placed near Colydiidae, and he may be correct. In some of the genera it is essential to consult the foreign literature, *e.g.*, in Cartodere where we have quite a number of species but probably not one of them is a native of North America. Have you access to Mr. Belon's writings on Lathridiidae? Have you Motschulsky's paper? I presume the latter's descriptions will cause some trouble in the absence of typical specimens but I believe to recognize a few of his species.

I am afraid that among the Coleoptera I collected last year in Arizona there is still another undescribed species of Acmaeodera. I have only quite recently found time to determine this set of Arizona material and could not send this species sooner, but I will submit it to you with the Lathridiids.

Yours sincerely,
E. A. SCHWARZ

Washington, D. C. April 7/99

Dear Mr. Fall,

Many thanks for your determination of the Arizona Apion. For the present I am unfortunately unable to appreciate the value of your remarks, because I have not yet commenced to study your paper in connection with the specimens. To tell the

truth I still feel the effect of friend Smith's Synopsis of Apion and recollect only too well the many hours of fruitless work I spent over this work. Our knowledge of the life habits of the N. A. Apion is ridiculously small, but when we shall have a better knowledge we will be able to distinguish between "species" and "varieties."

Some years ago I found at Washington a Holoparamecus which from Chevrolat's figures (in Ann. Soc. Ent. France, 1843) I determined as *H. villae* (=*singularis*) but the only specimen got lost through the carelessness of Mr. Chittenden. I see, however, from Mr. Ulke's list of the Coleopt. of the District of Columbia that he has this species. Ulke has retired from entomology but I shall make an effort to secure a specimen from his collection. His collection is for sale and if you have $5000.00 to spare you can have it. To me it is only worth about $500.00 on account of the types it contains; for the rest of his specimens I would not give anything for they are not properly labeled.

Last week I had one of our boys mount a box of my duplicates from Arizona containing the Apion (*A. pyriforme*) peculiar to *Mimosa biuncinata.* There were about 200 specimens in the box but only three of them are *entirely* black. This is my no. 3004 which has been determined by you as a possible new species. It seems that this species only rarely acquires its full coloration, but the reddish color of the elytra is certainly only a sign of immaturity.

Upon my return from Office I find to-day your letter of April 2nd. The specimens you send with it have not yet received but I shall probably find them tomorrow at the Department.

Yours sincerely

E. A. SCHWARZ

Washington, D. C. April 10, 1899

Dear Mr. Fall,

The box came safely to hand and the contents proved to be of great interest, since most of the species are new to our collection. I have looked them over yesterday and give you herewith some notes:

No. 1. *Scolytus ventralis* Lec. Agrees with specimens thus determined by Hopkins and myself but we have not compared them with the type. *Colonies* of the numerous western species of Scolytus are greatly desired in order to ascertain whether the abdominal armature is a sexual or specific character.

No. 2 *Micracis hirtella* Lec. Probably the ♂, but according to Hopkins, the ♀ of the species thus described by LeConte. Your specimen differs from LeConte's description and from the specimens collected by Coquillett in the structure of the antennae, the club being longer and the sutures distinctly curved. *Colonies* of these things are greatly desired. They live *within* the terminal twigs of deciduous trees. A specimen of the second South Californian species of Micracis will be sent to you.

A good list of the Coleoptera from southern California would be of great interest, and if you include the desert regions of eastern California I should gladly place at your disposal the list of species collected by Hubbard at Palm Springs, Cala. in early spring of 1897. It contains various undescribed species and several new genera.

Since the publication of Hubbard's Dinapate letters I have received 14 applications for specimens and there are only six specimens in our collections of which only one is absolutely perfect. It was the most difficult thing to breed this species and in spite of all possible care and attention the specimens crippled themselves in trying to emerge from the larval galleries. Of course I shall send you a specimen.

Yours sincerely,

E. A. SCHWARZ

Washington, D. C. April 13, 1899.

Dr. L. O. Howard,

Hon. Curator, Department of Insects, U. S. Nat. Museum.

Sir:

I have the honor to transmit to you herewith a framed portrait of the late Mr. Henry G. Hubbard. In view of what Mr. Hubbard has done for American Entomology in general, and; more

particularly what he has done for the collections of the U. S. National Museum, it seems to me appropriate that the portrait should find a place in the rooms of the Department of Insects at the National Museum.

Respectfully,
E. A. SCHWARZ

Washington, D. C., May 3, 1899

Dear Mrs. Slosson,

If you have one or two Floridian specimens of *Anthonomus brevirostris* to spare I should be very glad to get them for the Nat. Museum collection. I see from Linell's description (Journ. N. Y. Ent. Soc. V, 1897, p. 50) that he mentions the "slight aeneous lustre" but this lustre has either disappeared in the type specimens, or the light in the office is too poor (the windows are never cleaned), or I have become a little color blind.

Typical specimens of *Sunius binotatus* look of course quite different from the pale form you sent me but if one has large series of specimens from all over the South it becomes impossible to fix specific limits. Not only the color but even the length of the elytra are variable. In the course of time, this species will be broken up into several "species" but for the present it is by far safer to refer your specimen to a variety or race of *S. binotatus*.

By all means please describe *Cossonus hamiltoni*. Take as a model Dr. Horn's description (in Proc. Amer. Philos. Soc., Vol. XIII, 1873, p. 439–440) of *C. crenatus* or *C. corticola*, and it will be easy for you to draw up the characters. The *sudden* and almost transversely-quadrangular dilatation of the beak, together with the sculpture of the thorax and the peculiar coloration (upper and underside) are sufficient for the recognition of this species. I have gone through the literature as far as it is accessible to me but fail to find that it has been described from the West Indies or Central America. I should be greatly pleased to look over your description and criticize it if necessary, and if you need examples of our N. A. species of Cossonus for comparison I should gladly send you a full set.

Yours sincerely,
E. A. SCHWARZ

Washington, D. C., May 12, 1899

Dear Mrs. Slosson,

I am greatly abliged to you for the two specimens of *Anthonomus brevirostris* which you sent with your favor of the 9th and which I have placed in the collection of the U. S. Nat. Museum.

Your description of *Cossonus hamiltoni* is an excellent one and could well be published just as it is. I notice in my series of 6 specimens (found by me at Lake Worth under old bark of *Sideroxylon masticodendron*, in June, 1887) that "the little central carina at the apex of thoracic depression" is an evanescent character and that it would be preferable to mention the smooth longitudinal median line. The sculpture of the underside should also be mentioned. I enclose a transcript of your description with a few additional characters incorporated.

The second Cossonus which you send is a species quite unknown to me, provided it is not an abnormal specimen. It has nothing in common with *C. corticola*.

Yours sincerely,

E. A. SCHWARZ

Washington, D. C., Febr. 10, 1900

Dear Mrs. Slosson,

I was greatly pleased to learn from your letter that you are again in the sunny hunting grounds of Lake Worth.

The small weevil reached me in somewhat dilapidated condition but is still determinable. Some years ago I had determined the species as *Limnobaris limbifer* Casey, and the determination is probably correct. In 1875 Mr. H. G. Hubbard and myself found two specimens in the sand along the inner shore of the Indian River, at old Ft. Capron, where there is no Uniola but some other coarse grasses. One specimen I sent then to Dr. LeConte but it has never been described by him, probably because he thought it was rubbed. It may be that Capt. Casey's type specimen from Florida originally came from the LeConte collection.

While I was at Lake Worth, in June, 1887, I pulled up several Uniolas and looked at the roots but failed to see specimens of the

weevil or any sign of injury to the roots. From what you say I have no doubt, however, that the larva will be found to bore in the roots or rootlets of the plant, and do not think that it bores in the stem above ground.

There is very little known of the life history of our Barini: a few develop in dead twigs, others are stem borers above ground, but most species (including the genus Limnobaris) are no doubt boring, in the larva state, in the roots of living herbaceous plants.

Yours very sincerely,

E. A. SCHWARZ

P. S. I would have answered your letter sooner, but being attacked by rheumatism I was confined to my room for the past week and found your letter only yesterday on my office desk.

E. A. S.

The Hughes Hotel,
Fresno, Cal.
March 11, 1900

Dear Dr. Howard,

I arrived here safely this afternoon, nine hours behind time, and telephoned at once to Mr. Roeding. But I only got Mrs. Roeding who informed me that Mr. Roeding had gone to his Foothill farm and that he would come down town early tomorrow. Mr. Dodd, the Hotel proprietor, also informed me that the Roeding family temporarily live now in his hotel but for to-day (Sunday) they are all on the farm.

My trip was rendered very unpleasant on account of the overcrowded cars and there was no sleep for me since there were four babies on board. I was greatly impressed with the beauty and grandeur of the pine region between Flagstaff and Williams, Ar. In certain localities many of the trees are dying but whether from the effect of the fires or from injury by a Dendroctonus I could not make out from the train. A Minnesota lumberman, who goes almost every year to Arizona and who is well acquainted with the Arizona pine region told me what he knew of the timber insects and from his account I infer that a Monohammus larva is the most injurious insect.

My first impression of this valley of California is that, with the exception of the plants growing on the prairie and the few oaks and willows along the river, the whole flora is an introduced one, and consists of a most remarkable mixture of tropical and northern species. The Washingtonia palm, the date palm, the various Eucalyptus etc. form a strong contrast with the wheat fields and apple orchards. I wonder why they do not raise oranges or cotton here. In coming up the valley (or rather down the valley) I noticed but few fig trees from the car window and only one large fig orchard. This was near Bakersfield, and the trees were still entirely bare of leaves.

The spring flora of the prairies is in full bloom now and even on the western slope of the Tehachapi Pass various species of Ceanothus and a lot of other plants quite strange to me are in flower there. The cultivated plants are however still very backward; wheat and alfalfa are still very small and of the orchard trees only the peaches and a single variety of pear show spring life. Some butterflies are about but they resemble most desperately our eastern species—*Danais archippus, Vanessa antiopa, Pyrameis hunterae, P. cardui* etc. I have not yet captured a single insect.

Yours ever

E. A. SCHWARZ

The Hughes Hotel

Fresno, Cal. March 12, 1900

Dear Dr. Howard,

Yesterday evening I got Mr. Geo. Roeding per telephone. He will come in town this morning at 9 o'cl. and fetch my traps and myself out to his ranch. The famous Californian weather seems to exist only in imagination, for there is today a damp fog as thick as a genuine London fog. I have been running about town since 7 o'cl. to get the many things one wants for a prolonged stay in the country and to make arrangements with the Express and Post Office. The banks are not yet open, so I could not attend so far to my money affairs.

Please address letters packages etc. c/o Mr. Geo. C. Roeding.

Yours sincerely,

E. A. SCHWARZ

Roeding Ranch
near Fresno, Cala.
March 13, 1900

Dear Dr. Howard,

Yesterday morning, Mr. & Mrs. Roeding arrived in town; they are both charming people and I had at once a long talk with Mr. R. on the fig question. He promised to have his wagon ready at once to carry me out to his ranch but expressed his regret that he could not accompany me since his nursery business kept him in town. In fact, as I wrote you before he is now living in town. There was a delay of several hours before the wagon come and it was 3 o'cl. P.M. before I arrived at the ranch. Mr. Roeding had insisted that for the present, I should occupy his house but on my arrival the key could not be found nor the foreman, Mr. Fisher, who was supposed to know where the key was. Finally toward the evening everything was arranged and I am the sole occupant of Mr. Roeding's house and take my meals with the men. The financial side of this arrangement has not yet been settled. The fare of the men is of course very simple but good enough for me; the drawback is that breakfast is at 5:30 A.M.

Mr. Fisher is also a very busy man and had just time yesterday evening to show me over the place and especially the fig orchard with the row of Caprifigs and the remnant of the tent. (?) So, I started out early this morning and began investigation alone, the weather being fine and quite warm.

I am afraid it will be quite difficult for me to fix up here an entomol. laboratory, unless I can get a room in Mr. Fisher's small house; for I would feel quite uncomfortable in Mr. Roeding's house when the family returns, but the matter will be settled as soon as Mr. Roeding comes out the next time.

Yours sincerely,
E. A. Schwarz.

Washington, D. C., February 11, 1901.

Dear Mrs. Slosson,

Having been in California for nearly one entire year I found upon my return to Washington on my desk an astonishing

accumulation of letters and boxes of all sizes. The latter contain at least 10,000 specimens of Coleoptera—mostly for determination, and it will take several months' hard work to dispose of them. There is no question that in one of these boxes there will be the Tachys and the Haliplus from Florida which you have been kind enough to send me. However I have not yet been able to dig out the box

As I wrote you before I take a most lively interest in the insect fauna of tropical Florida and shall always be greatly pleased to see and determine anything in the line of Coleoptera you may send me. Of course I cannot promise you that I shall be able to name for you the "puzzling" specimens you refer to in your letter of February 8th but I shall do all I can.

Yours sincerely

E. A. SCHWARZ

Washington, D. C., Febr. 21, 1901

Dear Mrs. Slosson

I think you are greatly mistaken in stating that "collecting is very poor" at Miami; for the little Rhyncophorid beetle you send me with your favor of Febr. 16th is worth four or five trips to Florida. I had never seen it before and it represents a family new to the fauna of North America. It belongs to the family Allocorynidae and to the genus Allocorynus Sharp. There is only a single species described, *A. mollis* Sharp which is quite distinct from that you found. The family belongs in the neighborhood of the Rhynchitidae but is well characterized by the small palpi, the peculiar mode of insertion of the antennae (on the underside of the beak), the remarkable form of the tarsi, etc. Your species should by all means be described at once, and if you will draw up a description I would gladly assist you. As a matter of course I would like very much to get a specimen for our collection at the National Museum and I urge you to spare no effort to find additional specimens. Do you remember under what conditions you found the specimen.?

. . . .

I have finally found the box you sent me last year containing the Tachys and Haliplus for which I thank you greatly. We

have plenty Floridian specimens of that new Erchomus and the Bryoporus, so I have not made use of your kind permission to retain the specimens.

Yours sincerely
E. A. SCHWARZ

Williams, Ariz.
May 25, 1901

Dear Dr. Howard,

Herbert and myself arrived here safely this morning. Owing to the prevalence of coal dust and coal smoke, my cough started badly after leaving St. Louis and to make the matter worse we ran at Albuquerque into a terrific sand storm which still continues.

The country here around is extremely mountainous but looks very promising entomologically, so that in the course of time we should be able to make a good collection. My outfit is extremely defective and I hope to get from you the necessary implements, especially in tin boxes in the course of a few days. Wrapping paper is also quite desirable since this place is a poor market.

I had been careless enough in Washington to leave the arrangements for this trip to Mr. Ashmead but he mismanaged the whole thing and it turned out that we would have to stay in that great cattle yard, called Kansas City, one entire day and the best part of the next day. I could not stand that and so we abandoned Ashmead and left him in the lurch i.e. in Kansas City. This evening, however, he came along with the Fish Commission people, and we said the party good bye in full view of that splendid mountain, Ben Williams, which arises immediately behind the town.

The air is splendid here and as soon as this hurricane stops we shall go in the woods which extend to within 2 minutes walk from our hotel.

Yours sincerely,
E. A. SCHWARZ

Williams, Ariz.
June 1, 1901.

Dear Dr. Howard,

We are here only six days but it appears quite evident that we shall bring together a large and valuable collection and this in spite of the fact that I can do myself but little entomological field work at present being still unable to climb the smallest hill. This region is, entomologically, of extreme interest: there is the queerest mixture of boreal and lower Sonoran species. The season is too early now for a full development of the insect fauna and the bulk of the herbaceous plants and insects probably make their appearance not before the beginning of August. The country around Williams is of the same character as that around Flagstaff except that instead of the San Francisco Mt. we have here Ben Williams Mt. (9800′ high) which will most probably not be ascended by me. The whole region is thickly covered with lava blocks of all sizes; there was originally on the hills and mountains a rather dense growth of Coniferous trees (Pines in the lower and spruce in the higher altitudes), with small oak trees and a few other species of shrubs interspersed. There is a very scanty but quite varied growth of herbaceous plants in the hills while the great open plateau north of this town is covered with sage brush. The greatest drawback for this region, besides cattle, sheep, donkeys, etc., is the presence of the Saginaw Lumber Co. which since a number of years is making the most strenuous efforts to convert these hills and mountains into a naked wilderness of rocks. Moreover this entire region is frequently overrun by fires. I do not believe that I shall see a single acre of virgin forest. I send you this with a small portion of the collection made by us thus far, in 4 packages and consisting of 8 boxes.

Cigar box No. 1 does not need any attention except that the three vials in the top layer (containing lizards etc. collected by Herbert) should at once be turned over to Dr. Stejneger's department of the U. S. Nat. Museum.

No determinations of species sent herewith are requested but I would like to know whether or not the boxes arrive in good conditions; and, further, whether or not I shall continue to send on living material.

Many thanks for the outfit you sent me and which arrived in good condition. This city is the worst place for getting supplies I ever met with: not even packing paper and string can be obtained here, and what little can be obtained is at exorbitant prices ($\frac{1}{2}$ pint of alcohol 50 c)

I think my health is improving, at least my cough has subsided but it takes me still one hour to climb 100! For the present the base of the little hill only 5 blocks away from our hotel furnishes ample opportunity and material for collecting. But even to reach this place requires the laborious ascent of about 50 feet.

Yours sincerely,

E. A. Schwarz

P. S. Inclosed please find list of material sent herewith.

P. S. Please send me a few sheets of manila wrapping wrapping paper; also a ball of string; please also return the tin boxes, and finally please tell Tom to pack up and send me, in several good boxes, the vials and corks I left in my private room.

E. A. S.

P. S. My address is Tollfree Hotel, Williams, Ariz.

Williams, A.,
June 11, 1901.

Dear Dr. Howard,

Strong winds continue to blow here day after day and not only interfere somewhat with entomological work but also seem to retard my recovery. I make it a point to make two short excursions every day, and I think I am somewhat improving. At any rate my circumference has decreased more than 3 inches during the past fortnight but my climbing capacity is still extremely limited.

Our entomological collections are fast increasing. The insects affecting Coniferous trees are of course taking the front rank in interest and I wish Dr. Hopkins with his herculean strength and big axe were here to help us. For the present I have to confine myself to the study of the insects affecting Pinus. The Spruce zone commences at about 7500′ elevation and it is very doubtful whether I shall be able to get so high up.

In looking over the wooded hill-sides in the Pinus-zone one sees here and there a dead tree. Many of these trees have been examined by us and I have come to the conclusion that most, if not all of them, have been killed by the Dendroctonus. There appear to be three species of this genus on these mountains (there may be one or two more higher up) of which two attack healthy trees so that the latter succumb sooner or later. Both species seem to be undescribed. The third species which is flying about everywhere in great number has, strangely enough, not yet been found by us *in situ*. It is possible, however, that this species is imported in pine logs coming from the southern slope of Ben Williams Mt. We got between 14 or 15 species of Scolytids in all from Pinus sp. (5 undescribed among them) of which we traced the life history of 8 species but none of them appears to be primarily injurious to the pines. They are merely followers of the Dendroctonus.—The oaks furnish thus far only one (not injurious) species of Scolytids, *Micracis n. sp.,* while in the Aspen we discovered a wonderful new genus of Scolytids with a most remarkable life history. The Juniper (not Arbor vitae as written in my previous list) has one, apparently *not* injurious Scolytid (*Phloesinus* n. sp.) of which we have hitherto found only the galleries and dead imagoes. As stated before, the Spruce Scolytids have not yet been studied by us.

I have your letters of May 31st, June 1st (from Perm. Sec'y A.A.A.S. being a bill !!!) and June 7th, as well as ALL supplies for which I cordially thank you.

There is still spring weather in this elevated region, and before the beginning of the rainy season, which is about July 7th it is hard work to find many new things in Coleoptera. A Microlepidopterist, however, would find plenty of work even now. Larger Hymenoptera such as Apidae, Vespidae are still scarce and most of the spring flowers seed without the assistance of insects. Ants abound but belong all to well-known genera. Microhymenoptera are extremely plentiful though I suspect that more than one-half are parasites of Cynipidae and Aphids. I have not yet seen a single Diaspinous Scale; in fact found only two species of Coccidae; a common-looking Rippersia among a common-looking Lasius, and a Dactylopius on the roots of an

unknown plant. Not a single wild Roach seems to occur here (though we have plenty of Croton bugs); Acrididae are fairly numerous in specimens but few in species. Diptera are fairly numerous; the troublesome species here is not the house fly but *Lucilia caesar*. A big mosquito occurs here as a great rarity (hitherto only 3 specimens found) but we have not yet seen the larva. A few dragon-flies and some big aquatic beetles live in the artificial storage ponds and are no doubt recent advents from California.

Yours sincerely,

E. A. Schwarz.

P. S. Please send some more franks.

Williams, Ariz., June 14, 1901

Dear Dr. Howard,

I am somewhat disappointed at the slow progress of my recovery but still there is a progress visible. I am loosing in weight and stomacic circumference and am on favorable days able to make two excursions of about two miles each, provided there be less than 200′ of climbing. Entomology suffers considerably under these circumstances since Herbert shows but little circumspection and never collects anything of value if I am not with him. This region is evidently very rich in insects in spite of its arid character and if I were in good health our collections would be quadrupled in number of species.

The cheapest tickets we could get at Washington were excursion tickets to Prescott. This requires our going to that place shortly in order to have our tickets stamped and signed for the return trip. So I propose to leave Williams early next week and to procede to Prescott via Ashfork where we will make a short stop in order to see what kind of fauna is on that place about 1000′ lower than Williams. We shall return to Williams but when I cannot foretell at present. This depends on the luck we may have in collecting at Prescott. Fort Whipple is in the immediate vicinity of Prescott and from that place Dr. J. L. LeConte published many years ago a list of Coleoptera said to be collected by Dr. Elliott Coues. Ever since I got interested in the fauna of Arizona I strongly suspect that these things were

never collected at Ft. Whipple but much nearer to the Colorado plateau. In fact I feel pretty certain that they were collected in the upper Rio Verde Valley and not by Dr. Coues but by Dr. Edward Palmer. I think that a stop of 3 or 4 days at Prescott will dissipate any doubt about this point.

Williams is an expensive place and funds are running down rapidly. If I am gathering strength I would like very much to make upon our return to Williams, the trip to the Colorado cañon and, on our return trip to Washington, stop over for a week or so in the vicinity of Las Vegas, N. Mex. All this requires additional funds and I beg you now to send me, ON JULY 2ND OR 3RD, $130 per money order addressed E. A. Schwarz Williams, Ariz. Please omit "Tolfree Hotel" in the address, and do the same in all letters you may write me to Williams between now and July 2nd or 3rd. I shall write you from Ashfork or Prescott or wherever we may be during the next fortnight where to address me after July 2nd.

A large number of Department franks were unexpectedly found among the envelops you sent me but an additional supply (especially of the smallest sizes) can do no harm.

The weather is much cooler here than I expected but since there is but one thermometer in town which constantly indicates – 15° I cannot tell how warm or cold it has been here since our arrival. We have had only one warm day and on that day all sorts of insects were swarming. Yesterday afternoon we had quite a snowstorm and this morning Ben Williams Mt. shows a white cap.

I made the acquaintance of Mr. Dumont (or Dermont?) the manager of the Saginaw Lumber Co. At first he treated me rather coolly because, as I afterwards found out, he suspected that we were agents of the Interior Dep't. to look after the lumber stealing of his company. But he gradually thawed out and has invited us to make use of his lumbering railroad which runs about 20 miles south of Ben Williams Mts. into the very depth of this great forest of conifers.

How are the Proc. Ent. Soc. Wash. going on?—Please give my best regards to all the friends at the Dep't and elsewhere in Washington.

Yours ever,

E. A. SCHWARZ

Williams, Ariz.
June 17th, 1901

Dear Dr. Howard,

On Saturday last there was, in the early morning, ice on the little water (overflow of a windmill) that is to be found in this vicinity, but during the course of the day a change in the weather took place and real summer weather has since prevailed. I enjoyed the heat very much, was out in the open air most of the time on Saturday and Sunday, basked in the warm sunlight between the great boulders, and for the first time commenced to feel quite comfortable. Unfortunately the packing this morning quite upset me again at least for several hours.

During the three weeks of our stay here we made a valuable collection of Coleoptera although only a fraction of the fauna has been collected by us. Of the other orders we collected a mass of material which may or may not be of much value but which, at any rate, contributes to the knowledge of the fauna of this interesting region.

Herbert Barber sent on to the U. S. Nat. Museum a small portion of the plants collected by him. Since among these plants there are several upon which we found certain species of insects I would beg you to see that these plants ARE NOT DISTRIBUTED before our return to Washington. Herbert has written about this matter to Mr. Currie but I am afraid that his request will be disregarded.

Please let me know whether or not I shall send on LIVING caterpillars or other larvae. The package I mailed to you this morning contains such caterpillars. If they should make any trouble they can be thrown away.

We expect to leave here at noon for Ashfork where we may stay a few hours or a day according to the insects we find there. Last year when I passed that place I was favorably struck with it for the reason that there is not a single tree nor any other plant to be seen anywhere near. So there should be some very interesting insects there.

I have made arrangements with the postmaster here to have our mail forwarded, so please continue to write me to Williams, but omit "Tolfree Hotel."

We expect to return here in the first week of July, or sooner if we do not find any favorable collecting ground at Prescott or vicinity.

We found here the other day a little cocoon which I take for that of a *Limneria* which jumps far better than any jumping seed or *Cynips quercus-saltatorius* I ever saw. Unfortunately only one specimen has thus far been found.

Yours sincerely,

E. A. SCHWARZ

P. S. I read the other day in the Williams Calamity Howler that a party of scientists has been eaten by the natives of some of the Pacific Ocean islands. If that party consisted of Mr. Ashmead and the Fishery Commission men I feel sorry for the natives.

Prescott, Ariz., June 19, 1901.

Dear Dr. Howard,

Last Monday we left Williams at noon and one hour afterwards reached Ashfork which is about 1200′ lower than Williams but still in the volcanic region. There was a fine warm temperature of about 95° and in spite of the most desolate character of the vegetation we managed in the course of a few hours to make quite a collection of insects none of which we had seen at Williams and most of which (of the Coleoptera) are quite new. A few Junipers, Berberis and Lyciums constitute the arborescent flora while of the lower plants most of them were quite unknown to me. We stopped over until Tuesday afternoon and proceeded to Prescott. Here we have reached that region where, thanks to the goodness of Nature, washwater is very scarce and drinking water obtainable only with much trouble. The temperature is, however, quite lively, about 95° in the shade and seems to agree with me very well, for I was able this morning to walk across three ravines each about 150 feet deep and to do much more entomological work than Herbert who collapsed on account of the heat and absence of ice water. I collected quite a number of species of Coleoptera but not a single species of those mentioned by LeConte as occurring here. However one days experience is not enough to form a judgment of the character of the fauna.

There are again large Pines on the rocky hills around the City but the oaks are those of southern Arizona (Quercus arizonica and *Q. emoryii,* the latter plentifully supplied with Cockerell's Brachyscelid gall), and the Coleoptera and other insects found thus far remind me more of southern Arizona than of the plateau region. Prescott is more than 5000 feet high! Since I see that this warm and dry climate of this region is manifestly most beneficial to me I have decided to run farther down the road and spend a week or so at Hot Springs which is said to be a beautiful spot situated in a cañon where the temperature is about the same as at Yuma. If Herbert cannot stand the heat and absence of ice water I shall send him back to Williams where I could join him when summer temperature has reached that elevated region.

Before leaving Williams I received your letters of June 10th and June 12th. I have made arrangements to forward my mail to Prescott or Hot Springs.

Yours sincerely,

E. A. SCHWARZ.

(Castle Creek) Hot Springs,
Ariz., June 27, 1901.

Dear Dr. Howard,

Since last Saturday we have been at this out-of-the-way place in the midst of one of the wildest and most rugged surroundings I have hitherto seen in the West. Hot Springs is apparently within the very heart of the Wickenburg Mts. but since Castle Creek Cañon in which the springs are, is extremely deeply cut in, the altitude of the place is not quite 2000′. The flora and fauna remind me somewhat of those at Catalina Springs near Tucson but there are various trees and lower plants here which are unknown to me. The insect fauna is of course radically different from that of Williams, but on the other side, also different from that of any point in southern Arizona visited by Hubbard or myself. There has not been any rain here since last January and the whole country is dreadfully dried up. There is not a single flower here and even good-sized bushes are dried up. Insects are comparatively scarce just at this season but we made a fine collection in the waters of the Hot Springs (temperature

98° to 115°) as well as on the Acacias, Palo Verdes, Mesquites etc.

The climate is delightfully warm; as soon as the sun comes up, it is never below 90° and at 2 o'cl. p.m. we had it during the past week never below 105°, and on last Sunday we enjoyed 111° in the shade of *the* cottonwood tree. Under these conditions, insect collecting during daytime is quite unprofitable so we make our excursions from 5 to 8 o'cl. in the morning and from 7 to 11 o'cl. in the p.m.

This congenial climate and the bathing in the hot springs did me good; we took it easy, never climbed up the forges and never extended our excursions farther than half a mile.

Herbert got sick on the third day of our stay here on account of the great heat and more especially on account of excessive water drinking; but has now recovered. There is no other water here than that furnished by the hot springs and this is full of alcali and soda. This water is put in ollas and this brings its temperature down to about 85°. Every second day the stage brings a little ice down from Prescott, but this lasts only for a few hours.

We intend to leave here tomorrow and to return directly to Williams from which place I shall write you more about the insect fauna of Hot Springs.

I received here your letters dated June 15th (inclosing one from Hopkins), June 18th and June 20th; many thanks for them.

Please tell Mr. Clifton NOT to send Science to me. The Williams "Calamity Howler" is by far more satisfactory.

Yours sincerely,

E. A. SCHWARZ

P. S. The temperature in my room where I write this letter is 102° but since there is here no perspiration, one feels quite comfortable.

(Commercial Hotel)
Flagstaff, Ariz,
July 2nd, 1901

Dear Dr. Howard,

A serious disaster has overtaken us, and the only consolation is that we are still alive. We returned to Williams on June 29th

and had hardly fixed ourselves and our traps up for a thorough summer exploration of the country around Bill Williams Mts. when—this morning at 2^{30} o'cl. fire broke out in the town which spread with incredible rapidity. The Tolfree hotel was a mass of flames 3 minutes after the first alarm and 15 minutes later more than one half of the town was afire. The electric light had got out of order since the previous night so that when the alarm came our room was in complete darkness. It was impossible to save anything except those things one chanced to grab in the darkness.

Besides the loss of nearly all my clothing (Herbert lost his shoes and all his underwear) we lost our entire entomological outfit except those things that happened to be in our pockets or in our light satchels. I saved pocket book and our round-trip tickets, H. saved his box with pinned Micro-insects but lost his two lenses. I mourn the loss of my old entomolo. vademecum, all the entomolog and other books, my opera glass and all my jewelry (fortunately only 3 shirt buttons). But to my infinite regret we lost our entire biological and alcoholic collection made at Hot Springs!!

Since of the 3 hotels at Williams, two were burned out and the third badly scorched we took the early morning train and ran over to Flagstaff in order to refit and to consider further steps.

The disaster has of course crippled us badly and after running about for an hour I find that only a few of the lost things can be purchased here. The whole outfit sent me by the Department is lost, and when I shall have decided what to do now I shall take the liberty of asking you for at least some additional material.

The post office building at Williams was saved by some miracle.

One thing I beg you to do upon the receipt of this viz. to telegraph to Flagstaff (Commercial Hotel) whether the $130 have been sent to Williams.

We are somewhat used up for the present, and the entomol. results of this trip will be considerably curtailed in the future but that our spirits are not broken is proven by the fact that 4

hours after our arrival here we made a little entomolog. excursion and found a new genus of Coleoptera.

Yours sincerely,

E. A. SCHWARZ.

Flagstaff, Ar.,
July 4, 1901.

Dear Dr. Howard,

The worst feature of the burning of Williams, as far as it concerns ourselves, is that thus far I have no definite plans for the immediate future. Entomologically, we are badly crippled and all I could buy here at Flagstaff are chisels, hatchets, alcohol and pill boxes. Even if you are kind enough to send us another outfit, the loss of our nets, net sticks, umbrellas, sieves etc. can not be replaced here. We saved accidentally a dozen of empty vials of various sizes also 3 cyanide bottles but not a single box and only one collecting forceps.

Williams was by far the most favorable place for an exploration of this plateau; the surroundings of Flagstaff consist only of barren pine woods which have been ruined years ago and which cannot possibly furnish us much new material. There being no other stopping place on the plateau and the region east and west of the plateau along the Santa Fé R.R. being the most desolate desert, I fear we have to abandon any further exploration of northern Arizona and to retreat to Las Vegas, N. Mex. However, I shall try everything to stay on the plateau and I see two possibilities: 1) to re-establish our headquarters at Williams as soon as matters get quietened there; 2) to run to the Grand Cañon and stay there provided the hotel be not too expensive. Since every hotel and every store at Williams are burned, it is very doubtful whether we could find lodgings in that part of the town which is still standing.

At any rate we shall run over to Williams, as soon as I get the supplies from Washington which you kindly promised us and then let you know about our further movements. Do not write to me after the receipt of this letter until you hear from me.

Another bad consequence of the Williams fire is that owing to the excitement and to the inhaling of dense smoke my asthmatic

spells and my cough have returned so that I am not able to climb the slightest hill. However, I feel confident that this magnificent climate now prevailing on the plateau will speedily do away with these annoying things.

Yours sincerely,
E. A. SCHWARZ

Williams, Ariz.,
July 29, 1901

Dear Dr. Howard,

From day to day we are delaying our departure from Williams for the rainy season is now fairly upon us and many species of insects hitherto not noticed by us emerge from their long winter and summer retreats. However since money and time are getting short we shall leave here tomorrow and proceed to Las Vegas making only one short stop at Winslow.

We have hitherto been exploring only the region of Pinus, i.e. Merriam's Transition zone, but since of late weeks I commence to get somewhat stronger we have extended our excursions to the lowest Spruce zone, or at least to that portion of the plateau where Spruce trees are getting numerous. A beautiful cattle trail very gradually leads up one of the cañons to the very base of Ben Williams Mt. and since the distance from the town to the spruces is not more than 2½ miles with only one sharp ascent of about 200 feet, I was able to visit the Spruces several times. Very few spruce trees have been cut on the mountains and since few fires have ever entered the spruce belt the cause of the dying of spruce trees, young or old is most probably insect work. No wholesale destruction of trees takes place but here and there a dead or dying tree can be seen. The trees die from the top; consequently insect borers must be the cause, and, we found that a species of Scolytus (probably identical with the distinctive species observed by Prof. Hopkins in the northwest) is most probably the primary cause of the death of the trees. Nothing that is absolutely certain can be said on this point, for the investigation of these tough trees is immensely more difficult than that of the pine trees, and the two pieces of spruce bark which I sent you and which show the work of the destructive Scolytus repre-

sent a couple of hours' hard work on the part of Herbert and myself. Another species of Scolytus (probably Sc. *unispinosus*) seems to live only in the branches of the spruce and is no doubt of secondary importance. A Pityophthorus lives in the thinner branches and has no importance. There is also a *Hylesinus* living on Spruce but we failed to find a colony of this species. Hopkins found that a Buprestid, *Melanophila drummondi,* is primarily injurious to spruces in Idaho. Here we found one or two species of Melanophila on and in spruces but not very common and only in such trees as have been nearly killed by the Scolytus.

Various other insects, among them several undescribed Coleoptera. occur here on spruces but a thorough investigation of the fauna of this tree cannot be made by us this time. Even the fauna of Pinus is not fully collected by us although plenty of trees are close at hand. Thus, since the begin of the rainy season we notice a Pieris (Pimenapia ??) getting quite abundant on the pine but since it occurs only in the very tops of the tall trees we had no chance of getting specimens of the butterfly or its larva, except that a big spider was once good enough to grasp one of the butterflies and drop with its prey to the ground.

I really forget now whether or not I have acknowledged to you the receipt of the second relief box, containing cyanide bottles, cork, insect pins and corked boxes. To-day I received quite unexpectedly a third relief package containing enveloppes franks, writing paper etc. My best thanks for all these things which, all of them, are very welcome.—We dug for some time in the ruins of the Tolfree Hotel in the hope to recover the metal parts of our netsticks but failed to find anything.

I also have your letter of the 25th and I know that I shall find various other letters from you at Las Vegas. I expect to return to Washington sometime next month.

Yours sincerely,

E. A. SCHWARZ

East Las Vegas, N. Mex.
August 2, 1901

Dear Dr. Howard,

We left Williams on July 30th, spent the 31st in collecting at Winslow, about 50 miles east of Flagstaff and have just now arrived at EAST Las Vegas, N. Mex.

There is a confusion about the correct name of this place of which I was not aware before and I should be addressed at East Las Vegas, N. Mex.

I find here your letters (3) of July 20, July 22 and July 23, which I shall answer as soon as I get settled somewhere.

For the present I shall confine myself to one subject: I find also here two letters from Mr. Busck informing me that he has to go to Cuba and asking advance of money from me. I have written him with this, enclosing a check of 200^{00}. Now, it may be (and I think it is so) that I have still sufficient money in my bank to cover that check. But it may be otherwise and since you have probably my July salary on hand I would beg you to be kind enough to see that Busck gets his money, either from the bank directly, or by means of the sum you have in hand for me.

Yours in greatest hurry

E. A. Schwarz.

P. S. I see that this place is full of proclamations of T. D. A. Cockerell regarding plants, insects etc. but he himself is out of town.

Las Vegas Hot Springs,
N. Mex.,
August 18, 1901

Dear Dr. Howard,

I have to beg your pardon for having so long delayed answering your letters and more especially that of July 20th. I make it a point to be in the field the whole day, and for some weeks even in the evening, as there is now some night collecting since the begin of the rainy season. Thus I am always dreadfully tired after the day's work and by no means inclined to do any letter writing.

There has been some indecision regarding my plans: Your kind permission to stay out in the arid region for the entire summer is a most tempting one but on the other side the expenses of this trip have by far exceeded my estimates so that I have made up my mind to return to Washington some day this week.

My health is vastly improved by my stay out West but the root of the evil still remains and I dread a winter in Washington

climate and its consequences. Now, I am greatly obliged to you for your proposal regarding the trip to Texas next winter, and most gratefully accept this very kind offer. I am strong enough to do any amount of effective field work in a flat country like Texas but I feel uneasy regarding the nature of the work expected from me. The trouble is that I consider the case of *Anthonomus grandis* as a hopeless one as far as suggestions of remedial measures are concerned, but I hope you will give me definite instructions regarding work for the winter and early spring.

We have made here a very fine collection of insects (mostly of course Coleoptera) but of a quite different character than I expected. In order to understand more fully the fauna of the Transition zone as investigated by us at Williams, Flagstaff and the Grand Cañon it became advisable to visit another of the parallel ranges of the Rocky Mts. to make comparative collections. Las Vegas and its mountains are a little too far from the Colorado Plateau of Arizona but I did not know any point west of the Rio Grande of the requisite altitude that seemed fit for a stopping place (in coming east from Arizona I found out that Ft. Wingate would have been the best place) ; so we investigated the lowest position of the Transition zone at the mouth of the Gallinas cañon which is in the immediate vicinity of the Hot Springs. The leading plants viz. Pines, piñons, Junipers and oak shrubbery are here just as at Williams and even the Spruce trees descend to the very mouth of the cañon in shady places; but the insect fauna differs more from that at Williams than I expected. The reason or reasons of this difference are quite obscure to me for the present.

During this expedition we have made a very large collection—much larger than I anticipated after the first week's experience. The collection is in my opinion a very valuable one and, should it have arrived in Washington in good shape, will form an important addition to the Nat. Mus. collection. It will, however, require several months's work to mount the specimens.

I hope you have safely reached Denver and I would congratulate you for having escaped for some time the office life of Washington but for the fact that you are the Permanent Sec'y A.A.A.S. and consequently will have little time for recreation.

Many thanks for attending to my money affairs; the statement you inclose in your letter of the 12th is quite satisfactory, but I shall have many expenses upon my return to Washington. The salary voucher blanks you mention in the same letter have not reached me.—I never received a copy of your Fig article; as a matter of course, all the copies of my own article are at your disposal.

To-day is the first really ''rainy'' day we experienced on this trip. Of course it rains, since our arrival here, every day but they are short showers, though sometimes very severe ones. They do not interfere much with collecting though we are wet all the time.

Yours sincerely,
E. A. SCHWARZ

Havana, Cuba.
Febr. 16, 1903

Dear Dr. Howard,

I have just safely arrived here but to my great consternation I find that my baggage which I checked from Washington direct to Habana has not arrived with my steamer. I do not know how long it will take to recover it but since it contains besides all my collecting outfit I shall be seriously crippled for the next week or so as far as general collecting is concerned. It will however not interfere with my capacity of observing.

Mr. Ferrer has not yet made his appearance, nor did I find a letter from him at the hotel Pasaje. I hope to hear from him, however, tomorrow.

It is apparently very hot here but I suppose that within a few days I shall get used to the climate.

On the train from Jacksonville to Miami I had the great pleasure of meeting Prof. Comstock who intends to spend some time at Miami for the purpose of collecting spiders.

Civilization has extended largely all over tropical Florida, and my old collecting grounds of Lake Worth and Cocoanut Grove are quite irrecognizable to me and entomologically utterly ruined. This whole country is at present overrun and overcrowded with

American tourists and it was with difficulty that even here at Habana I got a dilapidated room at the Pasaje Hotel.

Please address me until further notice at Hotel Pasaje, Havana, Cuba.

Yours sincerely,

E. A. SCHWARZ

Habana, Cuba,
Febr. 17, 1903

Dear Dr. Howard,

I succeeded this morning in recovering my baggage which had been sent by mistake via Tampa, Fla., but it was hard work, for one is sent here from office to the other office before one gets at the right one. There remains only the trouble about Cayamas, for no one knows where this place is and still less how to get there. At the mailing division of the Post Office I was informed, however, that there is such a place in Santa Clara Province, and that it is a newly established post office. But that was all that they could tell me. I hope, however, that, as promised, Mr. Ferrer will be here to-day or tomorrow, or that at least he will send me instructions how to reach him. To make sure I have just sent him a note.

It is raining hard to-day and the air is very sultry.

Yours sincerely,

E. A. SCHWARZ.

Habana, Cuba, Febr. 18, 1903

Dear Dr. Howard,

It is still raining but I got finally into communication with Mr. Ferrer who through one of his Cuban friends sent me explicit directions how to reach his place. This trip with its several changes on the railroad and winding up with a 3 miles horse ride appears to me, in this strange country, much more formidable than a trip into the very midst of Arizona. Still I shall set out next Friday (day after tomorrow) when Mr. Ferrer will be kind enough to have his horses at the station.

In the meantime I found out that also in the Province of Habana several attempts are being made at cotton cultivation.

I am also informed that the country, wherever the soil is rich enough is full of a "wild cotton" (probably cultivated cotton run wild since many years). Capt. W. Hughes who is the manager of one of the numerous real estate companies that have been formed here since the war is greatly interested in this cotton problem and promised me to bring me out to several places in Habana and Pinar del Rey provinces where cotton is being cultivated on an experimental scale. However, he does not know anything about the *Anthonomus grandis.*

I called this morning on Dr. Fernandez, President of Acad. d. Ciencias and was most kindly received by him. He does not speak English so we conversed in French. All the publications of the Academia are placed at my disposal so I think I can complete our set of Gundlach's Fauna Cubana. He also gave me letters of introduction to various members of the Academy and also to Dr. José I. Torralbas who is Professor of Zoology at the University (Successor of Dr. Gundlach) and who seems to be the scientific factotum of this place. Unfortunately he speaks neither English nor French or German, but with some difficulty we went along moderately well. He informed me of the whereabouts of the Gundlach collection which to my surprise is not kept at the Academy nor at the University but at the Institute del 2a Enseñanza (2nd Highschool). Armed with other letters I proceeded to the Instituto and was again very kindly received by the Director and the Professor in charge of the Museum, neither speaking anything but Spanish. However I spent a couple of hours examining the Gundlach collection of Cuban insects which is in absolutely perfect condition and certainly of great importance to us as far as the types are not preserved in the U. S. I saw the *Anthonomus grandis,* one specimen (with few exceptions all species are represented by a single specimen each) without specified locality and many other interesting things. The Lepidoptera alone suffer from exposure to light and will be lost within a few years. The collection comprises 160 small glass-covered and hermetically sealed, boxes and extends over all Orders. The whole being placed on vertical shelves along the walls only the lower portions could be examined a little more carefully. There are of course many unnamed

species in the collection and most of the Diptera are without names. Further particulars I must leave until I return to America.

In spite of the rain I had yesterday my first little excursion on Cuban soil: I took a boat and went to the foot of the old Morro Castle but it proved to be a miserable hunting ground: nothing but cosmopolitan weeds with a corresponding well-known insect fauna. Moreover I was finally ejected by a squad of U. S. infantry who informed me that without a pass from the Colonel no one was allowed to come anywhere near the Fort. That is Cuba libre!

Yours sincerely,

E. A. SCHWARZ

Address c/o Mr. Edward Ferrer, Cayamas, Cuba.

P. S. I was just closing this letter when Mr. Jos. G. King of this city called upon me. He is a young and energetic farmer from Alabama who has settled in Habana and owns several farms and ranches in this province. Since two years he has planted cotton (Sea Island cotton) and has made each year one bale per *acre*. He says that he had collected all the injurious insects to cotton he could see and sent them to the Agricult. Exper. Station at Auburn, Ala., but never heard any word from the Station. He is quite sure that there is no Anthonomus grandis in his cotton nor did he hear of it in the Provinces of Pinar del Rey and Habana. He will drive me out tomorrow to the cotton patches nearest to this City and also show me the 20-years old cotton plant which grows somewhere near by. Mr. King is evidently a good observer and you would greatly oblige me by sending him all the literature on *Anthonomus grandis* which you have at your disposal.

His address is Jos. G. King, O Reilly 38 Habana, Cuba.

E. A. S.

La Magdalena,
Cayamas, Santa Clara, Cuba.
February 20th, 1903.

Dear Dr. Howard,

After traveling one entire day over 3 Cuban railroads and for the last six miles on Mr. Ferrer's Cavita I finally reached

this much-out-of-the-way place and was most hospitably received by Señor Ferrer (who, by the way, is a Cuban by birth and has his name pronounced Ferrér). Having not the slightest idea of the location of the place, and the railroad ticket they gave me at Habana bearing a name I never heard before things looked rather gloomy. There is a change of cars at Matanzas and another one at Colon. Here I got the first definite information about the location of Cayamas which in fact is not a village nor a city but simply another name for Mr. Ferrer's plantation La Magdalena. This is situated about 5 miles of Yaguamaraz (which you find on any recent map of Cuba) in the southeastern part of Santa Clara Province, only 7 miles distant from the southern coast of the island and about 16 leagues west of Cienfuegos. According to Mr. Ferrer this is one of the wildest parts of the entire island, mostly savanna lands studded over, as is usual here, with innumerable Royal Palm trees. From time to time there are smaller or larger tracts of timber land but there are also vast stretches of what in Florida we call sawgrass prairie but there is no stagnant water anywhere except near the coast where there is a famous swamp (I have not caught the name) running parallel with the gulf.

Mrs. Ferrer who is a Canadian lady, also received me most kindly and I was given a fine room which of course is arranged like any other Cuban room i.e. there are no window panes and in order to see anything one opens the big door.

I wonder what I shall find out here; the country looks very promising entomologically. Wild cotton is said to be plentiful in the country but on coming here from Habana I saw only a single plant in the savannah besides many others growing in the gardens of the poorer class of the Cubans.

Yesterday, at Habana, I had my first experience with Cuban cotton. In the morning, Mr. Jos. King of Alabama came to me and we took the electric car to Vedada from which suburb a walk of half an hour brought us to a little garden near a negro shanty in which there were 6 cotton trees, one of which, now in nearly prostrate condition is said to be 20 years old. They belong manifestly to the Sea Island cotton variety but are much degenerated. There was certainly no Anthonomus grandis on these plants, nor

any cotton worms but a most conspicuous enemy of the plant is a Phytoptus which forms on the leaves a larger or smaller number of galls of the usual form but infests also the young clusters of buds and prevents their development. Another cotton insect conspicuous from its numbers is a Dactylopius which swarms at the base of each boll, protected by the "scales" of the flowers. Whether or not it is injurious to the bolls I could not determine. Shortly after breakfast (which is here between 10 and 12 o'cl., a.m. two Cuban gentlemen called on me. Señ. Manuel Peralta y Melgares and Señ. Felipe Perozo, the latter being dragged along by the former to act as interpreter, but in the course of the conversation it was discovered that Mr. Peralta can speak a little French; so we went along nicely. Mr. Peralta is a correspondent of the Department of Agriculture and greatly interested in the cultivation of cotton in Cuba and since he possesses various farms in the province of Habana he has on everyone a patch of Sea Island cotton. Time being short we went out to his private residence at Guanabacoa, about 7 miles from Habana where he has three patches of cotton. The largest one is Sea Island cotton, about one acre in extent, the soil according to Mr. Peralta himself being of very poor quality; and appearing to me a mere heap of stones. Nevertheless the plants were in splendid condition, a multitude of unopened bolls, some mature ones (a few days ago picking had taken place), very few flowers and few flower buds to be seen on the plants at this season. I failed to find any injurious insects on the plants excepting a single leaf harboring a rather numerous colony of Aphids which were fed upon by two specimens of *Scymnus leuroderus* Muls. (a species common also on Jamaica and Montserrat), and a solitary larger Coccinellid larva (probably Coccinella sanguinea). On the same field there was a gigantic cotton tree, at least 25 years old which Mr. Peralta declared to be "Algodon silvestre" i.e. the wild cotton of Cuba. I have never seen this variety before but from the shape of the bolls and from the nature of the fibre and seeds I presume it is a derivative of Sea Island cotton. There were likewise no insects injurious to this tree. The second, smaller cotton patch, is likewise in Sea Island cotton and did not harbor a single Antho-

nomus; a few leaves were found to be eaten into by a grasshopper but the author of the damage could not be seen. The third patch is in Mr. Peralta's garden and consists of 200 or 300 plants of Egyptian cotton. Wherever the plants were shaded by trees they were badly infested by the Phytoptus mentioned before but otherwise there was no insect upon them. Here are also 4 little trees called by Mr. Peralta "Cultivated wild cotton" a form of cotton strangely intermediate between the Sea Island cotton and our short-stapled cotton, the bolls being rather large but the seeds being for three-fourths smooth and pubescent at the basal fourth.

As to the Anthonomus the inferences of this visit near Habana are 1) The picudo is either absent in the Province Habana; 2) Or it does not occur at this dry season. 3) It does not affect the Sea Island Cotton.

Just in front of my room here at La Magdalena, Mr. Ferrer has early last December planted what he calls the "Kidney Cotton" and which is the wild cotton of this province. The tree is now more than 6 feet high and bears profusely. The arrangement of the seeds within the bolls is radically different from that of any other variety of cotton known to me.

Please address me until further notice c/o Mr. Eduardo Ferrer etc.

Yours sincerely,

E. A. SCHWARZ

La Magdalena,
Cayamas, Cuba.
February 24, 1903

Dear Dr. Howard,

Rain! Rain! Rain! They all tell me that we are now in the midst of the dry season but so far it has rained here every day since my arrival, and I find that the only difference consists in the fact that in the dry season it rains seven days each week, and in the wet season every day each week. However, it is to be hoped that we have only a moderately wet spell. As matters stand I have thus far but little seen and, entomologically, nothing of importance, but at any rate I am getting a little acquainted

with these strange surroundings and with the conditions under which cultivation is carried on in this remote corner of Cuba.

Last Saturday I had my first experience in looking over a Cuban plantation. Unfortunately Mr. Ferrer insisted that it was "impossible" for an American to go afoot in this country, and so, in spite of my protests, they put me on a mule and off we went. As a result I did not see anything of entomological interest as I did not dare to dismount. We went down to the infested cotton field. As Mr. Ferrer has no doubt written to you, he has cut down by far the larger portion of the field and only a small corner, with less than 100 of the tree-like plants remain. In the meantime each of the cut-down plants have come up again to a height of about two feet, arising from the old roots in a multitude of separate stems. The whole field is difficult to find on account of the multitude of tall, shrub-like weeds which overrun here in a remarkably short time every cultivated spot except the banana plantations. Then we went to the second, not-infested cotton field, about 1½ miles distant from the former. Here the Egyptian cotton plants (which are more tree-like than any other cultivated cotton I ever saw) are still standing but so deeply buried into the tall weeds that I would never have been able to find the field myself. I think the simplest explanation of the immunity of this field is that the weevils have not yet found the field. There is, however, a marked difference in the nature of the soil, in the surroundings themselves and in the character of the vegetation.

In the afternoon (i.e. after breakfast) I insisted on going out afoot. So I went along in the search of the infested field. On my way I saw many specimens of a pink-colored Hibiscus, apparently a Cuban plant and which from the structure of the buds and fruits may possibly be the native food-plant of the Anthonomus, although I did not see any trace of it. A heavy rainstorm came up presently and cut short my excursion. I had of course used my beating net on the grasses (now mostly dead) and other low vegetation and saw myself that in spite of the warm weather insect life is, for the most part, dormant at this season, as but few species are about, and few specimens can now be found. A few species of Butterflies, all N.A. species, are

about, a few dragon flies, a big Anthrax, lots of Honey bees (the only larger Hymenopter besides a Sphex), a fine Coccinellid, quite new to me, *Coccinella sanguinea* and a few other small Coleoptera, a few small and common looking Heteroptera and Homoptera. No Orthoptera to be seen except the very young larvae of some crickets.

In the evening I had of course to listen to the story of the hormiga brava (the burning ant) and the hormiga loca (the crazy ant) about which Mr. Ferrer has written to you. He feels a little vexed at the short and—to him—unsatisfactory answer he received from you on this subject which as I have now found out is firmly believed in by everyone in this section of the Island. So on Sunday morning the entire population of La Magdalena turned out and we had soon found a colony of the hormiga brava (Solenopsis *geminata*) and hormiga loca (a common house ant the name of which I have forgotten but it occurs also at Washington, D. C.). The connection of the latter ant with the Atta (which is here by far the most injurious insect) remains a mystery to me but is no doubt also a supestition.

After this experience Mr. Ferrer and myself *walked* out in search of one (of) the species of wild cotton growing hereabout (from which I took home a tin box full of infested buds in order to raise parasites); and the group of wild cotton (kidney cotton) is about 400 yards distant hidden by tall shrubbery and grass and quite difficult to find. There is certainly not a single weevil on these plants, which are covered with buds, squares, young and mature bolls, and there is no indication that there were any weevils on them during the past months. On our way home we found another wild Mal*vaceous* plant, apparently a Malvastrum but both the buds and the fruits are too small to harbour the Anthonomus. After breakfast a big rainstorm set in and lasted several hours after which I had only to investigate the hardwood logs which Mr. Ferrer had cut last fall and under the back of which I found a lot of fine insects. In the evening some Noctuids etc. came to light, every species being entirely new to me.

Monday (Feb. 23rd) morning there was a drizzling rain but I went out and visited the only piece of original forest remaining

in the nearest vicinity of this settlement. It was my first visit to a tropical forest and every tree and vine is new to me. The undergrowth is awfully thick and full of spiny vines. The interior hardly harbours any Mal*vaceous* plants but there may be some on the more open edges. There is no possibility of using the beating net in this jungle and by working with my umbrella under great difficulty because everything was dripping wet, I found that on the living vegetation there is no insect fauna at this season but that quite a variety of insects, mostly Coleoptera, is to be found on the dead vines and branches, most of the species being small or very small and brand new to me. The rain became heavier and heavier so that I came home thoroughly wet. In the afternoon it rained 1.25 inches (dry season!)

On Tuesday the roads were without any bottom but the rain had stopped and I went out to look at that wild Hibiscus plant. I failed to find the Anthonomus but after prolonged searching I found two "bolls" which some time previously had been punctured by something which must have the greatest resemblance to an Anthonomus. A little viscid fluid exuded from the wound and upon carefully cutting open the fruit it was to be seen that the insect had fed on the young seeds nearest to the wound. There was certainly no larva within the fruits.

After breakfast I continued my circuit around the hammock mentioned above but did not see any Malvaceous plant. Here I saw however the first genuine Cuban butterflies and tore my butterfly net in the effort to get what appeared to me the rarest of them. Again I got a large number of strange Coleoptera from the dead vines, but the absence of any Chalcids or any other Microhymenoptera is very strange. A scorpion under loose bark was altogether too big for any of my collecting vials. Spiders are also very few in numbers and by no means conspicuous either in size, color or shape. A heavy rain shower wetted me again and drove me home.

My health is excellent but one must get accustomed to this sultry weather; everything is and remains damp and my cotton buds which I collected day before yesterday and which I kept in an open glass jar are covered with mould.

Mr. Ferrer sends his regards to you. He and Mrs. Ferrer treat me most kindly and do all they can to make me feel at home in this strange corner of the world. The rest of the inhabitants of this settlement gradually get accustomed to my strange doings and commence to bring insects to me.

Yours sincerely,

E. A. SCHWARZ

La Magdalena,
Cayamas, Cuba.
February 28th, 1903.

Dear Dr. Howard,

The solution of the question as to the original food plant of *Anthonomus grandis* in this section of Cuba proved to be an extremely simple one. Of course it is possible that the *A.* has here more than one original food-plant but my investigations of the past few days only showed a single wild-growing food-plant viz. the wild *Gossypium* of eastern Cuba, popularly called the Kidney Cotton, a rare plant which grows singly or in little groupes in the shrubbery on, or near to, the open savannahs. During the first days of my stay here I trusted to Mr. Ferrer's statement that the *A.* was never to be found on this plant and did not pay sufficient attention to it. The reasons why Mr. Ferrer (who is quite familiar with the weevil and its working on cultivated cotton) overlooked the *A.* on the Kidney cotton are very plain: 1) the plant is not common and grows usually in places not readily accessible to a person riding on horseback; 2) the weevil does by no means occur on every plant or every group of plants; 3) the weevils are much rarer on the Kidney cotton than on cultivated cotton; 4) the effects of the work of the weevil on the Kidney cotton are infinitely less visible than on cultivated cotton, i.e. a square or bud infested by the larva does not show the least outward sign of the infestation and an infested boll looks exactly like a healthy one; 5) owing to the tall and dense grasses and weeds in which the plants grow it is quite impracticable to find fallen squares or bolls on the ground; moreover, as far as I can see the falling of infested squares is an exception rather than the rule.

Otherwise the working of the *A.* on Kidney cotton does not differ from that on cultivated plants: I found bolls containing 4 or 5 larvae, others with only one or two, in the squares or buds there is only one larva; punctured (for feeding purpose) squares occur but no punctured bolls. I must say, however, that we are here in the midst of the dry season where the growth of all wild plants is practically brought to a standstill and only plants under irrigation make progress, so that it is to be assumed that during the rainy season the weevils are more common on the kidney cotton.

This kidney cotton is manifestly either the native species of Gossypium here or it has been brought by the Indians from Central America to Cuba long before the arrival of the Spaniards. Its fiber is inferior in quality to the semi-wild ''Loose'' or ''Silken'' cotton; the ''Algodon sylvestre'' of western Cuba but some use is made of it by the natives who know the location of every plant in their own neighborhood. Occasionally one or two trees of the kidney cotton is planted in the yards of a Cuban family, but the Loose cotton is by far preferred as a semi-cultivated tree near the houses.

All my efforts to find any trace of the *A.* on this Loose Cotton or on any species of Malvastrum or Hibiscus have hitherto failed.

The roads near this settlement being impassable the past week until yesterday I begged Mr. Ferrer to visit the second Egyptian cotton field day before yesterday and found the *A.* in full force. A month ago, Mr. Ferrer is positive there was not a single weevil on the field. In addition there is *Dysdercus suturellus* at work on the seeds of the comparatively few open bolls.

The weather seems to have cleared up and it is very warm now, which, however, does not prevent me from taking long excursions. It is only the queer way of taking the daily meals that prevents me from being in the field the whole day.

Sincerely,

E. A. SCHWARZ

La Magdalena, Cayamas, Santa Clara, Cuba. March 10th, 1903

Dear Mr. Fall,

Your welcome letter of February 9th has been forwarded to me to Cuba and reached me only yesterday. Of course I should

have written to you before leaving Washington but in my usual way neglected it. Meanwhile I hope that the Ptinidae and Zygopini of the National Museum have reached you in good condition. The type of the genus Copturus is not at the Nat. Museum but I have added to the lot sent to you a species from South America which belongs to the group containing Schönherr's type of the genus. Casey is manifestly right in separating our N. A. species from the typical Copturus; in fact Schönherr has placed them in a separate group.

What *Catorama tabaci* Guér. is I do not know and I am unable to send it to you. In former editions of the European Check List it was placed as a questioned synonym of the common *Lasioderma serricorne.*

Among the Ptinidae sent to you you will find a specimen of the Chilian *Trigonogenius globulum* Sol. to prove its identity with LeConte's *Tr. faretus.* You will also find specimens of a new Hedobia which was originally imported with wooden frame work from Japan to Washington. It continued to be destructive in the National Museum for several years until we exterminated it with liberal applications of bisulphide of carbon. Recently, however, Mr. Pratt has found two specimens near Alexandria, Va., and the species deserves at least to be mentioned in your Monograph.

Ptinidae from Mexico and the West Indies are mighty scarce in our collection but as soon as I return to Washington (which will be the case within 3 or 4 weeks) I shall send you at once what we have. Here in Cuba I am greatly disappointed regarding the richness of the Ptinid fauna. Not very far from the plantation where I reside for the time being there is a piece of original timber land which if it were in Florida would swarm with Ptinidae, especially the genus Hemiptychus but it seems that these beetles do not occur here and I got only two specimens of a Ptinus (*sensu latiore*), a Petalicen (1 specimen), a thing near Caenocara (one specimen), and a big thing with all antennal joints triangular (one specimen). We are, however, here now in the midst of the dry season when insect life is more or less dormant in spite of the high temperature.

As to your list of Desiderata I have commenced with the beginning of it, and what I have accomplished thus far has been

sent to you. As soon as I return to Washington I shall continue this work and try my best to accommodate you with the Lachnosternas. A list of the Museum desiderata (as far as I have brought the N.A. material together) has been sent to you, and I shall take the liberty of sending the continuations from time to time. A standing desideratum of the Museum is the genus Chaetophloeus.

I am here in the midst of Cuba investigating the Mexican Cotton boll weevil and do a little general collecting in spare hours. No large Buprestids, Cerambycids etc. are to be (had) at this season but the number of undescribed small things one can find here in the course of a few hours is considerable. Cayamas is about 40 miles west of Cienfuegos and lies in the very midst of the sugar cane district of the island.

Yours sincerely
E. A. SCHWARZ

La Magdalena,
Cayamas,
Santa Clara, Cuba.
March 10, 1903.

Dear Dr. Howard,

Since we found out that the wild cotton plants are the food-plants of *Anth. grandis,* Mr. Ferrer (who has taken courage at my going afoot through the country with impunity and is now walking also) and myself have visited and examined every group and every solitary cotton tree within walking distance (from 1 to 3 miles) from the "batei." Furthermore I have engaged a Cuban, one of Mr. Ferrer's men and who knows every cotton tree for many miles around, and under Mr. Ferrer's instructions this man makes now a circuit around La Magdalena at a radius of not less than 6 or 7 miles and collects samples of squares or bolls of every cotton tree he finds. At first he naturally brought along the finest and best-looking samples but he gradually improved and is now able to distinguish the infested squares or bolls from the healthy ones and also knows now how to find the weevils. Finally Dr. O. J. Smith (a genuine Cuban gentleman and not to be confounded with any member of the great Ameri-

can tribe of that name) has taken great interest in this matter and also sends samples of weevils and infested squares and bolls from his residence, Natalia, which is about 7 miles southeast of here.

The result of all this is 1) that this entire section of Santa Clara Province is naturally more or less infested by Anthonomus; 2) that the weevils have not spread from Mr. Ferrer's cultivated cotton to the wild plants, but from the latter to the former; 3) that the weevils are more numerous on the Kidney cotton than on the Loose (Seminella) cotton, the latter when growing alone usually free of weevils but liable to be infested when growing among or near to the Kidney cotton; 4) Solitary plants or small groups of Kidney cotton are also occasionally, and solitary Kidney plants often, not infested 5) A larger number of wild cotton trees either planted near the houses or growing entirely wild are always infested and here the weevils are more numerous but never as numerous as on the cultivated Egyptian cotton. The largest number of Kidney cotton I saw growing perfectly wild numbered about 50 plants (some of them certainly more than 20 years old) and here I estimated that about 1 out of 20 squares (no green bolls to be seen at this season) was either punctured or contained larvae or pupae of the *A.;* 6) the existence of the cotton weevil in Cuba was entirely unknown until my arrival not only to the Cuban planter but also to the peasants and workmen. The circumstances under which Dr. Gundlach found his specimens seem to be not recorded, or the records have been lost.

Ever since we found the *A.* on the "Loose" cotton I have given up all hope that there exists a cultivated species of Gossypium which is immune from the attacks of the *A.* Mr. Ferrer thinks that *every* plant of wild cotton can be exterminated on this island with comparatively little expense but I hardly think that this is possible. At any rate it is absolutely certain that under the present circumstances cotton cultivation in this section of the Island is simply impossible in the absence of any direct remedy against the *A.*

The great desideratum is to ascertain the distribution of the A. in Cuba but to accomplish this it is absolutely necessary to master the Spanish language fluently (my own Spanish makes

upon the peasants here much less impression than your French upon the Parisians) and to be able to ride on horseback, and finally to sleep in the huts of the natives and to partake of their food (yams fried in lard). To the latter point I would be able to conform but being deficient in the others, somebody else has to do the work. All I can do is to return to the more civilized western parts of the island where they have roads and hotels and where I have been promised to have carriages and guides.

There is in Cuba an American Daily newspaper, the *Havana Post* which every week brings out big articles as to the possibility of Cuba as a cotton producing country. It appears to me that these articles are all written in the interest of some land-grabbing companies which flourish in Habana. They are of course written without any knowledge of the existence of the *A.* in this country.

The rains which I encountered here during the first week of my stay have now stopped (save an occasional little shower) and the dry season is now upon us in earnest. The development of the Egyptian cotton and of the *A.* are at a complete standstill, and I am even unable to get a good supply of infested squares in order to breed parasites. I have in my room two sacks-full of infested squares which I manage to protect from moulding, but not a single parasite has as yet made its appearance.

My collection of Coleoptera makes good progress in spite of the dry season and in spite of the fact that I have to learn a great deal as to the mode of occurrence of nearly all insects. The absence of Lepidopt. larvae is very striking: in fact besides a few common looking Geometrid (excuse this antiquated term) larvae I see only a few Lycaenid larvae, two or three cut-worms in the vegetable gardens, those living in "rotten" cotton bolls (identical with the American species), and a very queer species (a Noctuid?) which destroys Mr. Ferrer's Cuban lilies (I hope to breed this). Still more striking is the absence of Micro-Hymenoptera, and among the few, that can be met with by sweeping or beating, none or hardly any are of unusual form. Mosquitoes are common here. During the first, rainy, week I spent here a ring-legged Culex was common in my room biting both during day

and night. It has now entirely disappeared to make room for another dark-colored species which is probably identical with one which is common in the woods and which is especially bad in the early evening hours. A third species which is extremely troublesome in the woods during day time never comes to the house. I do not remember having seen this species near Washington.

I suppose that Mr. F. has informed you that during the war his plantation was thoroughly destroyed several times by both the Spaniards and the insurgents. All his valuable fruit trees have been cut down and burned so that now there is but little chance for collecting scale insects. His orange trees harbor as far as I can see, only one species; on his Alligator pears I found two solitary specimens of a *Ceroplastes*. His cotton trees (which were not burned) are white with a common-looking scale, and on his improved Guavas there is occasionally a scale which, however, is infinitely more common on the wild Guavas growing on the savannahs. The Hibiscus mentioned by me at a former occasion is also occasionally covered with a white scale.

Mr. F. tells me that in order to see something of the Cuban insects it is necessary to wait until the beginning of the rainy season. This of course I cannot do and, in fact, I have made up my mind to leave here next Saturday or Sunday to return to Habana *via* Matanzas. The hospitality and kindness with which I am treated here by both Mr. and Mrs. Ferrer I am unable to put into words, but I feel that I should not longer impose upon them. Everyone else of educated people I meet with, treat me also most friendly and even persons quite unknown to me show signs of hospitality. Thus, I received the other day from the Mayor of Cardenas (the emporium for this section of the Island) a box of the finest Cuban cigars.

I have your two letters of March 3rd. They were very welcome to me though to tell the truth they were extremely short. If you and Mr. Marlatt want to get rid of your grip quickly you should come to this beautiful country of eternal summer where even in the month of February the younger generation of humanity goes about in *plenis naturalibus*.

My health is excellent: my neck and arms are of course burned frightfully by the sun and in spite of the dry season the numer-

ous scratches one gets here from the many spiny plants refuse to heal.

Yours sincerely,

E. A. SCHWARZ

P. S. My address until further notice will be Habana, General P.O. delivery but do not write me unless it be necessary, for my plans for the next two weeks are not yet matured.

La Magdalena,
Cayamas, Cuba.
March 18th, 1903

Dear Dr. Howard,

Since I wrote you my last letter I have been running about in the woods, in the prairies, along the edges of the cane fields, using vigorously my beating net, my umbrella and in fact every collecting method known to me. My general collection has thus considerably increased but I have never seen any specimens of *Anthonomus grandis* upon any other plant besides Gossypium. There is not the slightest doubt in my opinion that the original and only food-plants of the weevil are the varieties of Gossypium and here in Cuba the variety known as Kidney Cotton.

The temperature has risen considerably during my stay at Cayamas but it is now terribly dry so that very little development in plant and insect life takes place. The cotton plants do not produce any new buds or squares and I have great trouble in finding a dozen, or so, fallen squares to place them in my breeding bags. I have hitherto bred more than 100 specimens of *Anth. grandis* but not a single parasite!

Mr. Ferrer has been the other day in Habana and greatly alarmed the resident enthusiasts in and advocates of cotton culture in Cuba by his account of the condition of affairs in Santa Clara province. I am now on the point of returning to Habana and greatly wonder what I shall be able to find there of the weevil. I have been promised every assistance from several interested parties, and since there are wagon roads in the provinces of Habana and Pinar del Rio I may be able to move about somewhat. Here, in Santa Clara, there is not a single wagon road and since the country is extremely thinly settled I am unable to

undertake larger excursions. The man whom I had hired has within 15 days made the circuit around La Magdalena at a radius of from 5 to 8 miles (expense $30 U. S. curr'y) and brought samples of cotton from more than 80 localities (every isolated hut has here a name). The result is the establishment of the fact that the weevils are to be found in every direction just as in the immediate vicinity of La Magdalena. The ''Loose'' cotton is usually, but not always, free from the attacks of the weevil and just of this variety the man has brought a few samples of a magnificent variety which is manifestly of considerable commercial importance. Mr. Ferrer intends to plant half an acre or so of this cotton in the immediate vicinity of his infested Egyptian cotton in order to test whether or not this cotton will retain its relative immunity even in presence of a multitude of the weevils.

I intend to leave here tomorrow morning at 2 o'cl. (the only train on the Cardenas road leaves Campiña, the nearest railroad station, at 3:30 a.m.) and to lay over for a day or two at Matanzas where I probably shall not see much of wild cotton plants. Until further notice, letters will reach me at Habana, General P. O. delivery.

I hope that you have recovered from your grip; if not come to Cayamas where the temperature to-day at noon was 87° (with plenty of mosquitoes!). My health is excellent but of course the sun has burned me considerably and my arms and legs are covered with scratches and sores. I met, however, with an annoying misfortune in breaking the spring of my watch which until then was the only reliable time piece existing in this plantation.

Yours sincerely,

E. A. SCHWARZ

Cayamas, Cuba, Dec. 19, 1903

Dear Dr. Howard,

Mr. Ferrer and myself arrived here safely yesterday night after 14 hours' traveling from Havana *via* Matanzas and Cardenas. After driving out a portion of the bats, rats and frogs I occupied my old room which, however, is this time, in the absence of Mrs. Ferrer, not so conveniently made up as on my first visit.

During the night we had a severe cold wave from the north and at 6 o'cl. this morning the temperature was as low as 41°. At 7 o'cl. Mr. Ferrer, his overseer, who takes a great deal of interest in the Picudo matter (he speaks a kind of Spanish of which I fail to understand a single word) and myself started out on a long inspection tour, and in the afternoon (when the temperature rose again to 81°) I continued the same. The result is that owing to fires and cutting down of many cotton plants, the material for experimentation is greatly lessened since my first visit. The country is also much dryer than I ever saw it before; all plants including cotton have been on a standstill since many weeks, and weevils are scarce. We shall have to resort to irrigation to make the plants produce squares which of course will sufficiently increase the number of the weevils. The "Lion ants" were nearly frozen to death this morning and even refused to attack the weevils thrown into their nests.

I shall not commence to-day writing about what I saw and leave that for you to read after your return from St. Louis.

Wishing you a merry and healthy Xmas,

I remain

Yours sincerely,

E. A. SCHWARZ

Cayamas, Cuba, December 19, 1903

Dear Herbert,

I have safely arrived here in company of Mr. Ferrer whom I met at Havana at the appointed place and hour. We traveled by way of Matanzas and Cardenas thence southward by rail to Campiña. Thence a ride of two hours in total darkness on a very primitive road to Cayamas. Only a Cuban volanta is able to pass over such road in safety. Nevertheless I found one of my chloroform vials broken in my valise. During my first night in Cayamas a norther came down from the U. S., and at 6 o'cl. this evening the thermometer was at 41°. Since there are no overcoats, ovens and other appliances to produce heat at Cayamas we suffered severely and had to walk 3 miles before breakfast to keep warm. In the afternoon I started out again but this time I perspired like a pig, the temperature having risen to 84° and

butterflies, bees etc. were flying about. The cotton boll weevil (Anthonomus grandis) is still about and in some places quite common. Accidentally I captured a fine Cerambycid (Lamiid) new to our collection but of a genus not known to me.

Please send me, under frank of Dept. of Agriculture, some of those small envelopes for preserving Neuroptera and Rhopalocera (forty or fifty will suffice), and also some Cayamas labels, about 300.

My health is first rate and I hope soon to get rid of my rheumatism.

I hope you are in good health and wish you a merry and profitable Xmas.

Yours sincerely,

E. A. Schwarz

Cayamas, Cuba, Feb. 20, 1904

Dear Herbert,

It is too bad that I neglected so long to write to you and to thank you for your nice Christmas present and for your kindness in sending *Science* to me. It is not easy to write from here: during the day the strong breeze blows through my room so that it is next to impossible to sit down and to do some work. In the early morning hours when there is no breeze everything is wet including the writing paper and in the evening I have only the dim light of an acetylene light high above my table so that I cannot see anything.

In the cotton boll weevil matter there is no use for my staying and I shall return to Washington by the end of next week. I hope to find warm weather there because we had lately here some pretty cold weather, the temperature not reaching 75° and sinking as low as 50° which is not very pleasant.

There has not been any rainfall in this section of Cuba since October last. Everything is dried up and insects are much scarcer this year than they were during my first stay. I have collected hardly anything in the line of Lepidoptera, Diptera, Neuroptera, etc; I had to "concentrate" myself to one order but by doing so and by hard work I have brought together a very valuable collection of Coleoptera containing more than 100 species which I did not find last year. Last year there were some

big fires on this plantation and during the past month we had three other big fires so the country is black and bare of vegetation for a couple of miles around. So I have to walk long distances to get to a place where a little collecting can be done. Fortunately Mr. Ferrer girdled last summer most of the big Ceiba trees all over his plantation and I also had the luck of finding two of these big trees fallen to the ground and which were in the proper condition and in and on these trees any number of Coleoptera can be found. It is strange, however, that this remarkable tree does not possess a peculiar Scolytid but only Xyleborus and *Hypothenemus* which infest all sorts of trees. Many other good things were found by me in the two species of palmetto (Chamaeropa) that occur here besides the Royal Palm. Again I failed to get a collection of aquatic species except one or two little Bidessus and a species of Bagous which is able to swim as fast as any Dytiscid.

The cotton plants furnished this year quite a number of species which I did not see last year. This is probably due to the extremely dry weather, the cotton tree being, besides the sugar cane, about the only plant which has not suffered from the drouth and which attracts various interesting things.

Collecting at night did not furnish anything new this time and the few moths and beetles that came were not new to me.

Please stop sending Science to me.

I expect to return here in May and leave here part of my entomological outfit.

The other day Mr. Ferrer and myself went over to Cardenas where in one of the Public Schools they got a couple of boxes with some broken and Dermestes-eaten entomolog. specimens. Among the Lepidoptera there are a few fine Sphingidae and among the Coleoptera a lot of Curculionidae which I do not see around Cayamas but which no doubt are about during the rainy season. At Cardenas I also tried to get to the sea-coast but owing to the unfavorable strong wind we gave up the attempt after a couple of hours sailing in a very rough sea.

Hoping to see you and everyone else in the Office in good health, I remain

Yours faithfully,

E. A. SCHWARZ

La Magdalena, Cayamas, Cuba
May 10th, 1904

Dear Dr. Marlatt,

I arrived here all right last Thursday night and was again most hospitably received by Mr. Ferrer. The rainy season is in full sway here and my stay will be by far more interesting than pleasant. A heavy shower pours down twice or three times a day and the country resembles more a lake than terra firma. But everything swarming now with insects including mosquitoes, Hippelates, Homoloryia, kissing bugs etc. In spite of Mr. Ferrer's ants (Dorymymex) and the Cuban oriole the cotton crop is sure to be entirely eaten up by the weevil within the next three or four weeks but just on account of this fact I have now, after weeks and weeks of talking, convinced Mr. Ferrer that cotton can be successfully grown in Cuba in spite of the weevil. He is just now planting some 30 acres of cotton of various varieties.

Last Friday I ran out from Havana to Santiago de Las Vegas but Prof. Earle was unfortunately not at home. I sniffed, however, around for an hour at the Agricult. Exper. Station. Everything is of course new, and there is practically no Agric. Exp. St. in existence yet but only the old Orphan Asylum where the boys among other things were taught a little practical agriculture. The houses for the future members of the Station are rather small but inhabitable though they are not exactly what in the United States we would call a house. There are, however, many things, including houses, in Cuba which on account of the tropical climate must be made different from what we are accustomed in the States. The climate is, however, at this season a severe one, and should Mr. Kotinsky accept the position I would strongly urge him *not* to bring his family over before the end of October. Santiago is very beautifully situated, the surrounding country being a continuous orchard, although there is, besides the old Agr. College, not a single good house in the old town. It is quite close to Havana and there are three trains daily.

Mr. Ferrer is anxious to make the acquaintance of Prof. Earle and we have planned to go to Santiago by the end of this week

for a day or two. I shall then be able to report more fully about the place.

Hoping that all is well in Washington in general and at the Department in particular, I remain

Yours sincerely
E. A. SCHWARZ

La Magdalena,
Cayamas, Cuba, May 18th, 1904

Dear Mr. Marlatt,

It has been raining here continuously for the past 48 hours so that everything outdoors and indoors, including my regular writing paper, is either wet or damp.

In company of Mr. Ferrer I have again visited the Agricult. Experiment Station at Santiago de Las Vegas where we were hospitably received by Mr. and Mrs. Earle. Prof. Earle told me that the negotiations with Kotinsky have been discontinued since no agreement could be reached. So it is useless for the present to write further on the subject but if I can find the time will let you know what I saw at the Station. I merely mention that Mr. Carl F. Baker will be the Entomologist of the Station, and Mr. M. T. Cook of Indiana, the Botanist. I was informed by Prof. Earle that the latter is ''the best authority on Galls and Gall insects'' to which I did not make any reply.

I am much obliged for your letter of May 10th and for your efforts to get me a supply of Chilocorus. The few Orange trees at Mr. Ferrer's place and all the Orange trees at Mr. Earle's Station are in a bad shape. All the Florida Scales are here and there is an almost complete absence of Coccid feeding Coccinellidae. In fact the only species to be seen on the Orange trees is *Chilocorus cacti* and this is, for reasons unknown to me, quite rare. Coccinellids feeding on Lecanium are more plentiful here (I have 3 genera) while species feeding on Dactylopius and Aphids abound in species though with few exceptions not in specimens.

Besides Scale Insects, Mr. Earle has on his orange trees an abundance of Aleurodes which do not occur at Cayamas.

What I write more particularly about is to beg you to have me sent as soon as convenient 4 or 5 10c bottles of Oil of Citronella

which appears to be THE remedy for the Cuban mosquitoes. The latter abound of course now almost every where in Cuba: here, in the house at Cayamas, *Stegomyia* is the most abundant species while *Culex pipiens* is now more abundant in the fields than in the houses. No place in Cuba seems, however, more infested by mosquitoes (species unknown to me) than Cardenas where I spent a night last week. It seems hardly possible that people can live in that place. Now, I had a small vial of Citronella with me and while seated at the dinner table with Mr. Ferrer and his friends—everyone of us surrounded by a cloud of mosquitoes—I gave an exhibition of the power of Citronella. In less than a second there was not a single mosquito to be seen in the room. Thereupon was great astonishment and excitement among the inhabitants of Cardenas—in fact the greatest excitement since the blowing up of the Maine. I have distributed all the Citronella oil I have here and there are many more people that are clamoring for it.

A small bottle of this oil costs in Washington 10c so please buy for me 4 or 5 bottles (I shall refund you this money upon my return) and send them to me or better, addressed to Señor Eduardo Ferrer, Cayamas, Cuba, under official frank. I suppose the oil can be obtained in almost every drug store; the bottle I have was bought by Mr. Barber at Chas. J. Fuhrmann, Cor. 8th and East Capitol Sts., Washington, D. C.

As to myself I can stand the mosquitoes although I must confess that, should they get a little thicker, I would like a little of the oil for myself.

While at Habana I secured finally after much effort a copy of Gundlach's Ornithology of Cuba, from which I see that Mr. Ferrer's Solibio has been erroneously named by the Division of Biology. It is the *Xanthornus hypomelas* Bonap., family Icteridae. I have seen it with my own eyes that this bird opens cotton squares and bolls in search of larvae, pupae et imagoes of the Cotton boll weevil. It may be that one or two of the Cuban Blackbirds have similar habits.

Yours sincerely,

E. A. SCHWARZ

La Magdalena, Cayamas, Cuba.
May 21, 1904

Dear Herbert,

I was greatly pleased to get your letter of the 12th in this lonely place.—The cotton boll weevil is by no means injurious to the cotton plant; in fact the more weevils the better look the plants. They only destroy what man finds useful in the plant, viz. the bolls and their earlier stages, viz. the squares and the blossoms. Of course very little can be done in a few weeks stay at a place, since the natural history of the beetle is now well known. Try to ascertain whether the weevils are equally common on all fields you can visit; or if they are more abundant on one field than on another, try to ascertain the cause; for instance cleanliness in cultivation; whether old or new (i.e. planted this year); low ground or high ground, etc.—The number of weevils can best be ascertained by the number of infested (by the larva) squares you find on the ground beneath the plants.—Try and raise parasites of the weevil; this can be readily done by simply collecting the fallen squares (those containing the more full-grown larvae are more or less wilted and can be easily recognized with a little practice) and putting them in sacs (not in boxes) and occasionally moistening them. After from two to three weeks some hymenopt. parasites should make their appearance. Such sacks of infested squares after the latter have become sufficiently dry to protect them from getting mouldy can eventually be sent to Washington where the parasites, if there be any, could be bred.

Try to find out whether there is now either near Brownsville or Matamoras a cotton gin, or, if not, where the cotton is sent to for ginning, and how it is shipped.

Make a collection of all insects, or at least of all Coleoptera to be found on cotton plants.—Try and make collections of all insects that live on plants allied to cotton (Malvaceous plants).

They have here at Cayamas a small bird, the Solibio, (*Xanthornus hyponselus*) which visits the cotton fields in flocks, and digs out the weevils or their larvae from the infested squares lying on the ground, or from the infested bolls on the plants. If you have luck you may possibly observe with your good eyes some

bird in the Brownsville region that has similar habits. This is, however, a very remote possibility.

Yours sincerely,

E. A. SCHWARZ

P. S. Do not fail to write to Dr. Howard before returning to Victoria, stating that on June 15th or thereabout you would be at that place awaiting further instructions from him. E. A. S.

Cayamas, May 21st, 1904

Dear Herbert,

I have written the first two pages of this letter separately so that eventually you may show them to Dr. Howard.

Now I see from your very interesting letter that you are doing good work. Of course there is not a single locality in the world where good species can be found without hard work and I only hope that you will not overwork yourself so as to injure your health.

I have very little knowledge of the Brownsville region; in fact all my experience there was acquired on two short visits to San Tomas which is about 8 miles down the river and which appeared to me then an admirable locality, and I hope you will visit the place at least for one day.

There is nothing to collect on Padre Island; all the good things (Pogonus texanus and Throscinus) have been found on the shore of the mainland.

The mounting of a sample collection while in the field has been urged by many entomologists, f.i. by Mr. Bates, the famous explorer of the Amazons. The only objections I have are 1) that it takes considerable time; 2) that it increases the bulk of the baggage. In your case you can of course ship boxes with pinned material from Victoria to Washington or mail other boxes from Brownsville.

If you can get along with Armstrong—all right, but be a little careful. I understand from Mr. Schaeffer that Armstrong occasionally gets on a spree when it is difficult to manage him.

Fleas are extremely bad at Habana and Cardenas but for some reason unknown to me are nearly absent at Cayamas although there are dogs and cats in the house. Stegomyia is now the com-

monest house mosquito here and bites me much more frequently during day time than *Culex pipiens.*

If I am not mistaken I have published somewhere the Mexican story of the ''camponucha.'' This superstition has spread from Mexico to Illinois and Missouri.—I am afraid that your small Byrrhid from the mud cracks is nothing but the common *Limnichus lutrochinus,* a species common all over Texas.

Some 10 years ago I learned at Brownsville that the railroad was only about 10 miles away from Br. and now you write that it is 25 miles away. I am afraid that you will have to wait another 10 years before it gets anywhere near B.

I have no other suggestions to make to you except that you should be careful about your health. If you see young palmetto trees with half-dead leaves within reach do not fail to beat them heavily with your stick. A large yellowish Anthribid and a small black beetle of unknown position is sure to occur there, and besides various other things are likely to occur.

I have to stop my letter *here* for the rain has just ceased—a thing of very rare occurrence at Cayamas at this season—and I shall make an attempt to wade through the knee-deep slush to the cottonfield. I shall continue the letter, however, before tomorrow.

I expect to return to Washington on or about June 15th.

Yours sincerely,

E. A. SCHWARZ

La Magdalena,
Cayamas, Cuba, May 21st, 1904.

Dear Mr. Marlatt,

I am very much obliged to you for your letter of May 14th and to you as well as to Kotinsky for sending me specimens of Chilocorus *bivulnerus.* The box arrived all right but the specimens were unfortunately all dead! PLEASE try it again. Some ten years ago when Riley and Hubbard were at Montserrat, W. I., Pergande and myself sent the Chilocorus and many specimens arrived there alive. The best success was obtained by the following method: A wooden box of the proper size; a number of twigs infested by scale insects nailed or otherwise fastened to the sides

of the box so that they could not rattle about and care being taken that between the twigs and the sides as well the under and upper sides of the box, there is just room enough for the Ladybirds or their larvae to move about.

I think sooner or later Prof. Earle (or his successor) will ask the U. S. Department of Agriculture for scale-feeding Ladybirds; so it would be worth the trouble to gain experience in properly packing them.

If no Chilocorus can be obtained I would be glad to try the *Pentilia* (= Smilia = Epismilia = Pseudoweisea) misalla.

I enclose sample of the scale which at Cayamas makes most of the trouble.

Day before yesterday we had here 6.75 inches of rain; yesterday we had 2.25 inches and to-day we will have about 4 inches. The whole country is under water, and it is quite a feat to walk out to the cottonfield.

I expect to stay here until the first week of June; so if you send Ladybirds send them soon and in several instalments.

Yours sincerely,

E. A. Schwarz

Cayamas, Cuba, May 22, 1904

Dear Herbert,

My letter of yesterday was written in the greatest hurry in order to send it off on the same day; for in this season of frequent tremendous showers it happens about twice a week that the Cayamas people are completely isolated from the outer world. Since I am here we had at least one heavy shower each day, but on May 19th it commenced to rain in earnest, and within 12 hours we had 6.75 inches of rain; on May 20th we had 2.12 inches and on May 21st, 3 inches within one hour. Today it is sure to rain again, although at this writing, (6 o'cl. a. m.) the sky is clear.

The entire low region of Santa Clara Province is now more or less under water and wherever there is no water there is bottomless soft red-colored mud. The two creeks in this vicinity which were always dry in winter time are now large streams and the only bridge has been carried away by the floods. As a conse-

quence the field of entomological excursions has become extremely limited and some of my best localities are now beyond my reach. The maximum temperature is only between 80 and 85° but since the air is constantly saturated with water, the heat appears to be quite oppressive. However, I see that I can stand a Cuban summer weather; the question is only how long my shoes, pants, etc., will stand this rough treatment.

As a matter of course there are now a great many species of insects out which I did not see in winter time. In Coleoptera there are various species of the Otiorhynchid genera Exophthalmus and Pachnaeus swarming everywhere, 3 species of Pyrophorus fly about at night plentifully and can also be found during daytime; 5 or 6 Lachnosternas, one Cyclocephala, an Anomala, various Strategus, etc., etc. swarm at light. In that little bit of timber which I still can visit I find a great many species new to my collection, and on the cotton plants there is another big set of Coleoptera but none of them injurious to the plants. Besides the species mentioned above a great number of things come to light but there are here just as at Washington good evenings and poor evenings without any explanation in sight. I thus got various genera of Carabidae, Dytiscidae, Hydrophilidae and many species of various families new to me.

As a whole I got so many species of Coleoptera that I have not been able to keep track of the number of species I found. In all other orders of insects I am greatly disappointed at the Cuban summer fauna. In Diurnal Lepidoptera I see hardly anything that I did not see in wintertime, and while in the Heterocera there are some big Sphingidae out and the gigantic *Erebus odora* is flying about, all that comes to light is composed of small species of Pyralids, Tortricides, and Tineids, rarely a Noctuid. In Diptera a large number of Cecidomyids come to light but larger species are nearly completely absent. In Hymenoptera and Orthoptera hardly any new forms can be seen. In Neuroptera I see various Dragonflies about, which I did not see in wintertime, but I have not yet caught any of them. In Hemiptera various new forms of various families are now out.

Greatly astonishing is to me the scarcity of flowers but I am told that the season of flowers is at the end of the rainy season in September and October.

The very best thing I found, however is my old 1/8 inch Tolles lens which was in the proper pocket of my old vest which I had left here. Unfortunately there was nothing drinkable in Cayamas to celebrate this event.

The other day Mr. Ferrer and myself made an expedition to Cardenas. Here, through the kindness of one of Mr. Ferrer's friends I obtained finally a specimen of the genuine Jejen (*Oecactus furens* Poey, allied to Ceratopogon) which has been described from that town. Cardenas surrounded as it is by miles of salt marshes is further remarkable from the astonishing number of mosquitoes that infest the town. While sitting at supper with Mr. Ferrer and his friends in the dining room of the hotel everyone of us was surrounded by a cloud of mosquitoes. I had your bottle of Citronella oil along and gave now an exhibition of its power. In less than a second there was not a single mosquito to be seen in the room. This greatly astonished and pleased the Cardenasians, and I had to make a general distribution of the oil.

As I wrote you before I expect to return to Washington not later than June 15th but previous to my leaving Cuba I have to pay a visit to Prof. Earle, of the Agricult. Exper. Station at Santiago de las Vegas (near Habana) and hope to get for a couple days to Herredura in the pine region of western Cuba.

Yours sincerely,

E. A. SCHWARZ

Cayamas, Cuba, May 30, 1904

Dear Herbert,

I have your welcome letter of May 20th with enclosure. The Snow party will not do any great damage and will not in any way compete with you; they are only after big things, Lepidoptera and Coleoptera, and none of them understand anything about subtile collecting. That you have to beat the same twigs and branches on which Schaeffer and Doll worked last year is just what you should do. When Mr. Schaeffer was at Washington I was struck very much with the absence of small and subtile things a certain number of which no doubt occurs in the Brownsville region, and I hope you will bring some of them along.

Prof. Snow is a very pleasant old man, but you will not learn much of him regarding modes of collecting, etc. I also made some years ago the acquaintance of Mr. E. S. Tucker who came once to Washington.

My health continues to be in first-class condition but the flood and mud situation is getting worse from day to day. There is rain, real rain, every day and the two creeks have now overflowed their banks and my operations are now constricted to a narrow stripe of semifluid land where there are hardly any collecting facilities. Moreover comparatively little comes now to light since the moon is nearly full. Nevertheless I continue to find every day one or two species new to my Cayamas collection and only this morning I got two species of Cerambycidae, an Elateropsis and a big Prionid which I never saw before.

I expect to leave here next Sunday but it will be about the middle of next month before I return to Washington.

Address me at Washington. Yours sincerely,

E. A. SCHWARZ.

P. S. I forgot to tell you that after you had left for Texas, I had in Washington a short but marked supernatural inspiration —perhaps because I had taken one glass of lager beyond my usual quantum—during which I determined that Tree-Yucca larva of yours from Hesperia, Cala. It is unquestionably a Lampyrid but the genus is no doubt undescribed and has never been found in the imago state.

E. A. S.

Cayamas, Cuba, June 2nd, 1904.

Dear Dr. Howard,

(My regular writing paper got wet again and I have to use this note paper)

I had just commenced to write you a long account of my experience when your two letters of May 25th and May 27th resp. arrived. Leaving for the present everything else I must confess that I am greatly surprised about your plan of sending me right away to Guatemala. Of course I shall stay here at Cayamas until I hear from you in regard to this expedition but I would beg you to take the following into consideration:

First of all I am quite unprepared to undertake this trip on so short a notice being unacquainted with the topography, prevailing customs, mode of traveling, etc. in Guatemala; 2) while my stay at Cayamas during this warm and rainy weather has been greatly beneficial to my health, my shoework and clothing have suffered most severely by a month's tramping through mud, slush and water, so that necessarily I have to refit somewhere. And this cannot be done at Cayamas or anywhere nearby where absolutely nothing can be obtained. 3) I have only funds enough in my pocket to carry me back to the States. 4) Since I promised to be in Washington by the middle of June it would make me some trouble to adjust various private things by mail.

As a whole I am inclined to think that it would make only a difference of 4 or 5 days and not more than $50 if you would allow me to come to Washington before going to Guatemala.

However, if you insist upon your plan I could arrange all matters in New Orleans and in order to avoid any possible confusion I propose 1) to stay at Cayamas until I get further orders from you, but not later than Saturday, June 11th. It takes six (6) days for a letter from Washington to reach Cayamas if it does not rain heavily.

2) On Sunday, June 12th, telegram will reach me addressed: E. A. Schwarz, Hotel Europa, Cardenas, Cuba.

3) Monday, June 13th to Wednesday June 15th letters and telegrams will reach me addressed: E. A. Schwarz, Hotel Mascotte, Habana, Cuba. A letter mailed in Washington before noon of Saturday June 11th will reach Habana on Tuesday, June 14th and be delivered the same day.

Should I not get any orders from you until June 15th I shall take the Tampa boat on Thursday, June 16th.

Yours sincerely,

E. A. SCHWARZ.

Cayamas, Cuba,
June 4, 1904

Dear Dr. Howard,

Another box said to contain 24 larvae and 3 imagoes of *Chilocorus bivulnerus* has just come, and I am glad to say that, on

account of the correct packing and probably also because larvae were sent—the contents arrived in quite satisfactory condition.

The three imagoes were dead; of living larvae I count 14 and I see further 4 pupae in the box. This leaves 6 larvae unaccounted for, but the pupae are fastened to two sticks in such a way that I do not dare to take out the latter and to see what is beneath them.

All of the 14 living larvae commenced to feed at once upon the Orange Scale and I have liberated them upon one of Mr. Ferrer's orange trees which is badly infested. Whether or not it will be possible to colonize the Ladybird here starting with 14 larvae and 3 pupae—remains to be seen.

A copy of the *Washington Post* of May 28, 1904, containing an abstract of O. F. Cook's remarkable discovery in Guatemala, has just come to hand, and I have shown it to Mr. Ferrer. I abstain from repeating here the comments made by us, principally for the reason that the article in question may contain various inaccuracies and misstatements which are probably not in the Special Bulletin.

Please have a copy of this Bulletin sent to Mr. Ferrer, and I also beg you to have Mr. Ferrer's name placed on the list of those who get all publications of the Division or Bureau. He has not even Hunter's latest Bulletin on the Anthonomus.

The excessive multiplication of the House mosquito that has taken place within the last week or so renders writing extremely difficult, and I am making but slow headway with my report to you. I have a good collection of the mosquitoes of the Cayamas region although on account of the flooded condition of the country I can visit only a small portion of the plantation. I have collected various species which I never saw in the dry season though the mosquito fauna of Cayamas is evidently not very rich in species. Other species may, however, come later in the season. As it is, three (possibly 4) species are present in field and wood in untold myriads. In my room Stegomyia was at first by far the commonest species but it has become gradually rarer and a species of Culex (I think different from C. pipiens which is the house mosquito in the dry season) is now present by the millions.

Yours sincerely

E. A. SCHWARZ

Washington, D. C. November 18th. 1904

Dear Mr. Fall,

I would have responded sooner to your request but I have been absent in Texas for a fortnight and Mrs. Richmond brought me your letter only this morning.

1) I inclose a copy of Baudi's description of *Rhadine* (not in Ann. Mus. Civ. Genova, but in Berl. Ent. Zts. 1873). It is, however, not easy to ascertain whether the genus belongs to Mulsant's Anobiens or to his Dorcatomiens. From the description it belongs to the latter subfamily but Baudi has placed it among the Anobiens. A copy of Mr. Rye's remarks from Zool. Rec. is also inclosed.

2) The name *Eutylistus* is not preoccupied. The name *Tyloma* is also not preoccupied but since we have in Coleoptera Tylomus Schönherr and in mammals Tylomys Peters, it is not advisable to use the name Tyloma.

3) I distinctly remember the mode of occurrence of the Victoria, Texas ? Caenocara. It was found in a hard tree-fungus (probably genus Agaricus) in company of *Arrhenoplita ferruginea* and *Ennearthron* sp.

4) As to the Brownsville, Tex. species of Teretriosoma and Teretrius see Mr. Ch. Schaeffer's paper in the next number of Journ. N. Y. Ent. Soc., as soon as this paper is published I shall go over the descriptions. I merely want to say here that the Brownsville Teretrius was sent by me to Dr. Horn who answered that it was *not* his *T. levatus*.

5) A few days ago Prof. Fletcher sent to the Dep't of Agricult. a Ptinid from Montreal, Canada, which I at once recognized as *Niptus hololeucus*. It occurred in great numbers in a house at Montreal. Fletcher will probably publish something about this species in the next number of the *Canad. Entomol.*, and you should include it in your monograph.

Could you furnish for the U. S. Nat. Museum duplicate specimens of the Xylophili described by you?

Dr Howard has just submitted to me, for examination and report, 600 birds' stomachs from Texas. This thankless and laborious work will occupy me for the next five or six months!!

Yours sincerely,

E. A. SCHWARZ

Washington, D. C. Jan. 23rd, 1905

Dear Mr. Fall,

It is unfortunate that both Mr. Barber and myself are so overwhelmed with routine work that the Brownsville, Tex. Coleoptera are not yet fully mounted. About one-half of the collection is still in pill-boxes, but Mr. Barber, while in the field, mounted one specimen of each species he captured, and this set, as far as the Ptinidae are concerned is herewith sent to you with the other Ptinidae as far as they are mounted. Mr. Barber's collection of Brownsville Coleoptera is an important one, and a full list of all species will be made out. For this reason I beg to keep this *numbered* set apart from the rest of the Museum material.

Did you see Reitter's ''Analytische Tabelle'' etc. of the European Anobiidae (Byrrhidae) published in 1903?

For the next five or six months I shall not be able to occupy with Coleoptera: there are on my desk 1300 (!) birds' stomachs to be examined for the Cotton boll weevil investigation. During the past three weeks I have examined 250 stomachs—a very tedious and ill-smelling work.

Your desiderata of Brownsville species will be attended to—but when, I am unable to say.

Barber's Ptinidae will be sent to you tomorrow through Dr. L. O. Howard.

Hoping that you are in good health and in the further hope that in this year 1905 we will get your work on the Ptinidae, I remain

Yours sincerely
E. A. SCHWARZ

United States National Museum

Washington, D. C. Febr. 4, 1905

Dear Mr. Blanchard,

I was greatly pleased to get your letter and to learn that after your trying affliction you found courage enough to return to the Coleoptera.

As to your efforts to get specimens of, or information on, Throscus pugnax from the Carnegie Museum I would say that Dr. Holland has gone to England as far as I know. So you will

not get any reply from him just now. Moreover it is very difficult to get from him any specimen of any Order for study. The only specimen of *A. pugnax* which I ever found got lost while being sent to Dr. Horn.

I have made out, for my own use, a list of the Coleoptera described from the West Indies. No species of Throscus is known from there, and *Th. duvalii* Bonv. comes from southern France. The only species of Throscus I found in Cuba is, therefore, most likely undescribed and I send you herewith all my specimens in the hope that you will describe it. Of the 5 species of West Indian Drapetes I found three in considerable number of specimens of which I gladly send you some for your own collection.

I also send you the Throscid material that has accumulated at the Nat. Museum since last year. The most valuable portion thereof are the few species collected at Brownsville, Tex. by Mr. H. S. Barber.

I also put in the box for you a few specimens of *Throscinus schwarzii* Schäffer, and finally 3 species (for your collection) of which I would like your opinion. They are a Dasytid (probably new genus) and a Colydid (also n. gen.) from California and an Anthonomus from Texas which has lately appeared in enormous numbers on the cultivated pepper plants.

I shall tomorrow attend to your other questions and also to the Hemicrepidius but our material in that genus is far from being rich or otherwise valuable.

The box with the Throscidae will be sent to you through the Museum authorities. Since there is a little red tape here it will probably take a few days before it reaches you.

yours very sincerely

E. A. Schwarz

Washington, D. C., March 2nd. 1905

Dear Mr. Blanchard,

Mr. Barber and myself have examined our Anillus: we have only 3 species here, but in two of them, *A. debilis* and *A. fortis,* the tubercle or ocellus can be very plainly seen. In the 3rd species, *A. explanatus* (only one specimen) no trace of it can be seen but this species deviates in several important characters, *e.g.* the form of the mandibles, from the other two.

Whether the object is an ocellus or merely a black tubercle I shall not decide; under high magnifying power it is seen to be situated *on the front, i.e.* some distance from the clypeal suture. Mr. Barber has prepared a fine microscopic slide of this structure which slide is at your disposal if you wish.

I have done some hunting in the literature regarding the spiracles in Dermestid larvae but hitherto without any success but I shall let you know when I strike something. At any rate I send you herewith a perfectly preserved larval skin of Berber's Thaumatoglossa; also, for your collection a ♀ *Th. americana* Jayne.

A few more Hemicrepidius have turned up which are herewith sent to you, and I take this opportunity of adding one of my specimens of *Acritus atomus* for kind examination and comparison. Where did Marseul "boggle" (or bozzle ??) this species. Referring to Marseul's Histeridae I see that the species was entirely unknown to him and that he simply reproduces (partly in translation) LeConte's description.

Do I correctly infer from your remarks that you do not possess *Mastogenius subcyaneus*? If so you are welcome to the two specimens in the box. There is no special hurry in returning the Brownsville Mastogenius.

Yours sincerely
E. A. SCHWARZ

The New St. Charles.
New Orleans, March 14th, 1906

Dear Dr. Howard,

Both Mr. Barber and myself have reached here all right but the train unfortunately arrived on time, which upsets all my calculations for the day. After ascertaining that there was no telegram for us announcing a further postponement of the Guatemala trip, we proceeded at once to the Office of the United Fruit Co. to see whether Prof. Cook had engaged berths on the next steamer to Puerte Barrios, but as soon as the agent became aware that we belonged to O. F. Cook's party he overwhelmed us with a flood of scoldings not always expressed in choice language. He said that Cook with his orders and counter-orders had made him nearly crazy. We had to take the lesson meekly although we made a feeble attempt to prove our innocence.

New Orleans is an excellent market for outfits for a tropical trip, and I regret that I purchased one half of my personal outfit in Washington. Prof. Cook and party arrived this morning two hours late, and we have taken out the necessary papers from the Guatemalan consul and also our berths on the steamer Olympia which is to sail to-morrow morning. It rains to-day heavily here and I feel sorry for Cook who is running about town to buy things. Our baggage is unfortunately heavy and I cannot imagine how we can manage to transport it over the mountains of Alta Vera Paz.

Mr. Barber's hand is progressing satisfactorily and I think he will be all right upon our arrival at Puerto Barrios.

I was very sorry that I could not see you last Saturday and Sunday and wish you a good trip to Europe and safe return.

Yours sincerely,

E. A. SCHWARZ

Cacao, Alta Vera Paz, Guatemala. March 28, 1906

Dear Dr. Howard,

I am glad to announce to you the safe arrival of the entire expedition at this place in the very midst of the high mountains and primaeval forests of this wonderful country. This being the dry season it has hitherto rained incessantly ever since our arrival which, however, did not prevent us from going into the field. Keleps are plentifully here at certain places but whether or not this is a good locality for making observations on the relations between the ants and the Boll weevils remains to be seen. At any rate the cotton patches are in a very poor condition and seem to have but little attraction to both ants and weevils.

Cacao is a house about 12 miles north of Panzos, elevation about 800 feet, and situated immediately at the base of the remarkable vertical cliff from which 13 waterfalls are descending —a very strange view. On top of this mountain at an altitude of nearly 2500 feet is the hacienda of Mr. Fickert-Forst a German gentleman, who treats us in the most hospitable way and to whom we owe all the comfort we enjoy in this wilderness.

The health of the party is good, Mr. Cook has a little attack from some fever and Barber is temporarily laid up from having

been attacked by a swarm of black Polistes. As to myself I am still suffering from the effect of a 10 hours' ride on horseback from Panzos to our bungalo.

Yours sincerely
E. A. SCHWARZ

Cacco Trere Aguas, Alta Vera Paz,
Guatemala, April 25, 1906

Dear Mr. Clifton,

Since Dr. Howard has presumably not yet returned from Europe, I address this note to you.

Our party is breaking up next week, Mr. O. F. Cook and Mr. Jordan expect, next Monday, to start on an overland expedition through El Peten to southern Mexico. This is a dangerous trip which will take one month or longer and on which the rest of the party cannot possibly follow him. On the other hand, Mr. Lewten, Barber and myself have such heavy baggage that it will be quite impracticable for us to go to Guatemala by way of Coban. Morever, my experience in riding a horse or mule, on what they call here roads, is such that I refuse to make the trip.

To make the matter more complicated, the Ferrocarril del Norte does not take any passengers from Puerto Barrios to Raucho (from which place there are two days ride to Guatemala City). The United Fruit Co. steamers running from Puerto Barrios to New Orleans has long since stopped taking passengers to New Orleans or Mobile. After due deliberation we find that the only way to get out of this country is to get down to Livingston and wait there for the Hamburg-American liner which, in the course of 3 or 4 weeks will bring us to New York. We expect to carry out this plan and to start for Livingston toward the end of next week. There does not seem to be any yellow fever yet on this coast and a stay of a few days at Livingston will not hurt us.

Should we carry out this plan—and I have no doubt we will—the expenses of this trip will be much lower than anticipated, probably less than $500 for each of us.

I shall write definitely next week. Our party is in tolerably good health in spite of the wet weather. Best regards to all in the Office.

Yours sincerely
E. A. SCHWARZ

Livingston, Guat.
May 5, 1906

Dear Dr. Marlatt,

After three days' traveling our party consisting of Messrs. Leroton, Barber and myself, safely reached the coast and are now waiting for the Hamburg-American line steamer which is said to leave here about the 10th and which makes the trip from here to New York in about 14 days.

The heat is very great here and there are quite a few Stegomyia in town though there is apparently no yellow fever here yet. In spite of this fact, every harbor on this coast has quarantined against the other and we cannot even get over to Puerto Barrios from which the United Fruit Co. steamer Olympia carrying the U. S. mail to New Orleans will leave next Monday. This note will go with this steamer and will reach you more than one week earlier than our arrival.

As I wrote to Mr. Clifton our expenses will be much less than anticipated, in fact less than $500 for each, including transportation orders and requisitions.

The health of our party is good except that I am still sore from riding down from our mountain camp.

Yours sincerely,
E. A. SCHWARZ

Dallas, Tex., April 19th, 1907.

Dear Barber,

With some trouble I have reached this place but my hope of finding here warm and congenial weather was soon dissipated. When I came here on Monday the temperature was about 93° but the next day it fell within two hours to 44° so that everybody feels miserable. Yesterday afternoon it appeared to warm up a little but in the evening the wind came again from the north and to-day it is as cold as ever. Moreover, they had no rain in Texas since several weeks and everything is as dry as tinder.

The boys are working hard here and have found out various interesting points in the hibernating period of the Boll weevil. As a matter of course they put me to work at once to name their recent collections of Coleoptera which are quite considerable and

contain many good things though nothing of prime importance. The best things are a brand-new *Urodera* found by Pratt at Kerrville, and a fine new *Conotrachelus* found here by Pierce.

Yesterday afternoon when the weather was a little warmer Pratt and myself started out on a little excursion to a piece of timber near the Department cotton field, and using my umbrella I got within half an hour about a dozen species that are new to the Cotton boll weevil collection. I was quite surprised to find here such things as *Ino reclusa* and *Toxotropis fasciatus* which I always thought to be peculiar to southern Texas.

We have planned a great entomological excursion to the Devil's River (a little north and west from Del Rio on the Rio Grande) but we must await rain before starting on this expedition.

The laboratory here is well stocked with all kinds of entomological outfit, so there was no need for one to bring anything at all from Washington. The boys have even invented a new style of Cyanide bottle.

The letter of Clemons which you forwarded to me reached me this morning. I enclose it herewith so that you may know the situation. I regret very much the delay but this was unavoidable under the circumstances. Not being well supplied with cash at present I sent Douglas $5.00 and beg you now to send him $10.00 from the fund I left in your care. I wrote him not to use this money for ordinary purposes but to deposit it in a bank as an emergency fund.

It is so cold in the laboratory that I am hardly able to write. My health has not yet improved and I am quite exhausted from the little excursion of yesterday.

Yours sincerely,
E. A. SCHWARZ

Washington, D. C.
June 29th, 1909

Dear Herbert,

I have your letter of the 27th and although I regret that you shall not return here before the middle of next month I see from what you write that you enjoy your stay among the gypsy moth folks. I most sincerely regret to inform you that since you left here we had a great deal of trouble about Douglas Clemons. To

make it short after a few days of ailing he collapsed entirely and the most pronounced and aggravated case of tuberculosis developed. The doctor gives very little hope of his recovery but as a last resort we managed last Thursday to bring him on the train and he is now in Boulder, Colo. although I only heard that he has arrived at Denver and is still alive. He was of course unable to travel alone, so I persuaded Currie to take leave of absence and go along with him. I enclose the various postal cards and one letter which I have received from Currie.

This calamity affects me very much; I am quite nervous and take very little interest in any thing else.

Osgood has left Saturday for Chicago; Dr. Fisher is quite sick but expects to leave for the West sometime next week; McAtee will come to you next week to study the influence of birds on the Gipsy and Brown-tail moths.

Yours sincerely,

E. A. SCHWARZ

P. S. I got at the Office a Phengodes larva found in the stomach of an Armadillo at Kerville, Tex. The imagoes of your Lopherus developed all right.

E. A. S.

Washington, D. C.
July 1st, 1909.

Dear Herbert,

Since I know that you take much interest in our friend Clemons I enclose another letter from Currie which I received this morning. I wish you would write Douglas a line or two cheering him up as much as possible.

There is nothing new here. I had to leave my quarters at the Cosmos Club on account of the tearing down the two houses on Madison Square but I am already settled in my new quarters, 818 17th Str., now occupying the rooms vacated by Osgood.

The torrid weather still continues here.

Yours sincerely,

E. A. SCHWARZ

Address: Mr. Douglas Clemons,
The Boulder Tubercular Sanatorium,
West Pearl St.,
Boulder, Colo.

Ancon, Panama, Jan. 12th, 1911

Dear Dr. Howard,

Mr. Busck and myself arrived safely yesterday morning at Colon and after considerable amount of running about managed to get our railroad passes and other necessary things. We reached Ancon in the afternoon and were most kindly received by Dr. Canfield, but Mr. Jennings is sick and unable to help us along. This morning we met Colonel Goethals who at once took us in his automobile to his Office at Culebra where we were duly installed as employés of the Isthmian Canal Zone Commission. Other officials of the Commission like Dr. Gorgas and Col. Gaillard have to be visited by us but it is not easy to find them. At any rate we have been most kindly treated by the Canal Zone people and there will be no difficulty in finding a suitable headquarters for us along the line.

Weather is delightfully warm but entomological operations have not yet commenced. Mr. Pittier is located at Culebra but we failed to find him this morning. Mr. Goldman is located at Gatun and Dr. Meek at Colon.

As soon as we are definitely settled I let you know our address; for the present letters will reach us c/o Mr. Jennings.

Yours very truly,

E. A. SCHWARZ

Paraiso, I. C. Z., Jan. 14, 1911

Dear Dr. Howard,

It takes a long time and much running about before one can settle down along the Canal Zone but after due deliberation and personal inspection we decided to make our headquarter at Paraiso which is on the eastern side of the Canal, a short distance from the Miraflores lock and on the line of the French railroad, but one mile distant from the new railroad. Entomologically speaking, this place seems to be the best that can be chosen within the Canal Zone and a walk of less than one mile brings us out of the devastated district into the wooded mountains where there is at least one little creek which is not kerosened.

We have been assigned to a fine, airy room, in the hospital at Paraiso and almost everything we need is furnished partly by the Quartermaster Dep't and partly by the Sanitary Department.

Colonel Gorgas, Dr. Canfield and Mr. Jennings send their regards to you. Jennings is still sick and had to be transferred to the hospital at Ancon. Mr. Busck has caught a bad cold but has at once been attended to by the Sanitary Department. As to myself I enjoy this warm weather immensely and feel sure that the last trace of my rheumatism will have disappeared within a few days.

Yours sincerely,

E. A. SCHWARZ

Address of A. Busck and E. A. Schwarz:
Paraiso, I. C. Z. Panama.

Paraiso, I. C. Zone, Panama
February 3rd, 1911

Dear Dr. Howard,

Both Mr. Busck and myself are still at Paraiso and busy in exploring the insect fauna of the neighboring hills. In spite of the very pronounced dry season and of the fact that the entire arboreal flora has been destroyed by the Canal operations all over this district, insect life is tolerably abundant, and our collections rapidly increase both in extent and value. Our greatest enemy is the Sanitary Department which has most effectually done away, not only with the mosquitoes but also with all insects living in or near creeks and all other wet or moist places.

Agriculture on the Canal Zone is carried on in a very small and primitive way: here and there are a few scattered orange trees near the American or native houses but no trace of the Orange Aleyrodes can be found and hardly any Scale insects but the only colonies of Aphids I found were on Orange and and on a native species of Viteò. Sugar cane has some common-looking Cutworms and a large Acronycta (or allied genus) as enemies. Owing to the prevalence of the House ants (*Monom.* pharaonis and minutum) we have hitherto failed to breed these and many other insects. The living Banana plants do not seem to have any important insect enemies but most Chrysomelid beetles (*Porphyraspis circumdata* and a host of Hispinae) that feed in or on the allied plant genus Heliconia are also found on

the Banana. Corn is long since harvested and only the dry stalks are left; there are only a few forgotten ears left showing the work of Meliophila and harboring the usual fauna of Corn weevils and Sap-beetles (Nitidulidae) which are by no means always specifically distinct from those found in the States. Near the native huts an occasional Cotton tree (Pittier has a distinct name for it) can be seen. No trace of the Boll-weevil has hitherto been found by us but a good-sized, reddish Pyralid larva infests the bolls and its work resembles that of the weevil in the most deceptive way. We are trying to breed the moth. The rubber plantations are unfortunately remote from the Canal Zone in the few valleys which have not been kerosened by the Sanitary folks. I shall, however, visit a plantation which is about 4 miles east of Empire. There are hardly any other crops within our reach. Chickens seem to flourish here and there do not appear to be any chicken ticks; cattle, hogs, goats and sheep are not in favor with the Canal authorities and are raised only under strict regulations.

The Isthmus of Panama having no high mountain chains on either coast is the most arid and most unproductive part of Central America; its soil is too heavy and too shallow and in the dry season full of cracks. There is no even ground anywhere except in the Savannah region about the city of Panama (visited by us in a single day's excursion), and the hills are as steep as church steeples. Owing to the absolute dryness at this season the ground is excessively slippery and it is with the greatest difficulty that I climb the hills.

Mr. Busck had his eye severely injured by a branch of the climbing bamboo and had to go for a few days to the hospital at Ancon. Mr. Pittier is splendidly housed at Culebra, enjoys the use of Col. Gaillard's carriage, has a trained assistant (Mr. Christopherson from San Thomas) and a colored servant. He met with a severe accident nearly two weeks ago, breaking his wrist and straining two or three fingers. This does not prevent him, however, from going about and the other day he and the rest of the botanical force paid us a long visit to look at the big Bauhinia vine (about 300 yards long) and the new Coco (Cacao, *Theobroma*) tree discovered by us in the Paraiso hills.

Mr. Goldman (situated at Gatun) seems to be going on all right but is rather silent about his work. The other two members of the expedition, Dr. Meek and Mr. Hildebrand I have not yet met with; in fact it is difficult to find anyone along the Canal without making an appointment beforehand. Mr. Jennings is still sick but on the road to recovery.

I beg your pardon that I trouble you with this long letter. Mr. Busck and myself are in good health, and while I move about with the greatest care in the woods and along the steep trails I am still good for field work in the tropics and enjoy this warm weather.

Yours sincerely,

E. A. SCHWARZ

P. S. A consignment of six wooden boxes sent to me by the Bureau of Entomology has been duly received by me. These boxes are *no good* and three of them were broken when I got them. They are the most carelessly-made boxes I ever saw.

E. A. S.

Paraiso, February 13, 1911

Dear Dr. Howard,

Many thanks for your welcome letter of Jan. 23rd. If I am tardy in my replies please remember that two short excursions, or one longer excursion, each day; the taking care and packing of the collected material, writing diary and notes—are more than sufficient to tire out even the strongest entomologist.

No one seems to know exactly what is the matter with Mr. Jennings. Every week he is said to better but according to the latest report he will not be able to leave Ancon hospital for several weeks. Mr. Busck has recovered from his cold and injured eye, and the rest of the party, including the new arrival, Mr. Maxon, seem to go along all right including Mr. Pittier whose broken wrist of course can not heal so soon.

I am getting gradually acquainted with the localities along the Canal Zone, and it is very easy to reach from our headquarter at Paraiso any point along the Panama R. R. to make there an all-day excursion and to return to Paraiso at dusk. The smaller stations along the Canal have been much less thoroughly kero-

sened by the Sanitary folks than the big ones, and there is no want of collecting localities as good as one can expect during this dry weather. Thus we have visited the sabanas at Old Panama, Las Cruces (a native village on the Chagres), Matachin, Tabernilla and Bohio. The original forest has been cut down everywhere (with the stumps dynamited out), and the second growth, here called "djungle," forms an impenetrable thicket so that one has to collect along the trails which are sometimes tolerably good but sometimes very bad. There are no "hotels" in these smaller stations and usually no restaurants so that one has to take the evening train back to one of the larger places. Culebra, as the headquarter of the Engineering Department, has to be visited by us quite frequently (10 minutes rail road ride from Paraiso) since one can not do anything along the Canal Zone without having a permit from the "Colonels." There is no collecting locality at Culebra.

We get now tolerably well acquainted with the surroundings of Paraiso and since we also got considerable experience how insects can be found at this season, our collections are growing faster every day but there are hardly any large or brilliant things to be found (excepting butterflies which we do not collect). The grassy lawns (they are just as fine and clean as the White House grounds at Washington) which surround each large city here have an insect fauna which, with its small grasshoppers, common-looking Capsidae and small Flea-beetles, most strikingly resembles that found in similar localities in the States.

We are just making preparations for a larger trip to Porto Bello on the Atlantic coast and have secured the necessary permits and passes.

Last Saturday we got our first heavy rain shower lasting nearly half an hour, and myself got then my first thorough drenching from the outside although every day I get thoroughly wet from prespiration. The result is that I drink an immoderate amount of water (N. B. Paraiso is a temperance town without any kind of drinkables). Yesterday there was another heavy shower but I saw it coming over Ancon Hill and escaped.

On February 2nd and yesterday, Feb. 12th I sent you some boxes with insects, and am most anxious to learn of their arrival

in Washington. The great drawback of this Paraiso expedition is that it takes nearly 3 weeks before a reply reaches us from Washington.

Another lot of wooden packing boxes sent by you has been received by me. These were very carefully packed at your office but they are so poor that most of them arrived broken. Please do not send any more packing boxes since through the courtesy of the Commissary Department I can get suitable boxes at Paraiso.

I learn from Mr. Barber that Mons. Ernest Olivier of Paris (the grandson of the old entomologist Olivier and authority on Lampyrid beetles) has written to you requesting the loan of certain Lampyridae in the Nat. Collection. I recommend that his request be granted.

Mr. Busck sends his regards to you. Hoping that you and family are in good health, and with regards to all at the Office, I remain

Yours sincerely,

E. A. SCHWARZ

Address: Paraiso, Hospital, I. C. Zone.

[An Official Souvenir Postal, World's Columbian Exposition. Showing picture of The Agricultural Bldg.]

To Dr. Howard.

The citizens of Panama are very angry that they shall not have the fair to celebrate the opening of the Panama Canal in 1915. So a building similar to that above will not be erected here in 1915. But it may be that the Centennial celebration of the Canal opening be held at Panama in 2015: Quien sabe?

Paraiso, I. C. Zone, Feb. 13, 1911

E. A. SCHWARZ

Porto Bello, Panama.

Febr. 19, 1911

Dear Barber,

As I wrote you before it is not any easy thing to write a letter on an entomology trip in the tropics. Two excursions each day are after all a severe strain to me and I am pretty well exhausted when I come home in the evening.

Paraiso is after all a very good place for insects in spite of the devastations by the canal work and so are the other stations along the line which I have visited with the exception of the large cities, Culebra and Empire. The northern end of the Canal Zone from Gatun to near Bohio is now almost entirely under water and lost forever to entomol. investigation.

Paraiso will continue to be our headquarters but for the present we are on a larger excursion to Porto Bello. This place is just the opposite extreme to the Canal Zone: the vegetation is only too vigorous and virgin and it rains here all the time. The country reminds me of Livingston, Guat. or of the hills along the Rio Dolce. There is a complete absence of trails on the peninsula where the American town of Porto Bello is with its enormous stone crushing apparatus but there are a few trails across the Bay (which is about one mile wide) leading out from the old Spanish town of P. Bello. One of these trails is the old paved road to the city of Panama; we have followed it for about a mile but often sank into the mud up to our knees. Around the American houses there is the usual thorough clearing of every tree or bush and the grass is cut every week; so there is no fauna on these lawns excepting a few common-looking grasshoppers. Further up the hills there is a zone where the trees have been cut down but where the grass and the new growth is only moved twice or three times a year. Here is a perfect wilderness of morning glory vines and numerous other weeds, difficult to penetrate and here is an insect fauna not much different from that on the Canal Zone; but higher up the hill and west of the City extends the virgin forest unbroken for hundred of miles, reeking with moisture, full of vines and gigantic trees, without any trails. The insect fauna of this place is manifestly very rich and radically different from that of the Canal Zone but apparently very difficult to explore. We are here only a few days and probably have not yet met with the best localities but we expect to stay here for about a fortnight. The place is more troublesome to reach than it would appear from an inspection of the map. There is no possibility of taking a trunk along and the heavy hand baggage has to be carried (without anyone to help you) for more than a mile to reach dock No. 13 at Mt. Hope. There a little tug boat awaits

you which is much tossed about by the waves of the Caribbean Sea (you would have been badly seasick) but after 3 hours sailing the fine bay of Porto Bello is reached.

I have your letter of February 7th, also one from McAtee; also two letters forwarded by you. Many thanks for your kindness; the Cyanide and the fixative will not be forwarded to us from Paraiso. But on Washington's Birthday the Canal Commission furnishes a tug boat to the employees living at Porto Bello (which is a kind of prison) to spend the day at Colon or Panama and we intend to go along to look at our headquarter at Paraiso and to get some more clothing etc. I have also to attend the purchase of a new cheap watch, my own having broken its spring yesterday.

On two occasions I have sent specimens in pill boxes to Washington but have not heard of their arrival.

Yesterday was cold weather here, temperature only 72° at 6.30 a. m. and 84° at 2 p. m. and there were only 3 showers.

Our health is first rate and we are doing good work. With best regards to all at the office.

Yours sincerely,
E. A. SCHWARZ

Porto Bello, Panama,
Febr. 24th, 1911.

Dear Mr. Barber,

On February 22nd (Washington's Birthday) the Canal authorities furnished the tug Porto Bello to allow the workmen of Porto Bello to spend the day at Colon. Porto Bello is a kind of prison where nothing is going on not even base ball. Thus it was quite natural that a crowd of people went down at 6 o'cl. a. m. We joined it but instead of spending the day at Colon we took at once the train to Panama where we had a good dinner and where I purchased for $3.50 a new watch, the spring of my little watch having been broken some days ago. With this military discipline under which one has to live on the Canal Zone, a watch is indispensable. At 4 o'cl. p. m. I took the train back to Paraiso where I found your packages (Cyanide, Fixative mixture and Reinforced Cigar boxes) in excellent condition; repacked my suit case with additional material and on the next day took the morn-

ing train at 6.30 a. m. to Colon, took a carriage out to the lower end of pier no. 13 from which place we had to walk only a quarter of a mile to reach the tug Porto Bello which brought us to Porto Bello (sea being very rough) in 3 hours. Here we were treated at once with a tremendous rain shower which lasted for about two hours but before 4 o'cl. p. m. I set out for a short evening excursion in the forest back of the old Spanish fort. Here I have, in the course of time, found various places where one can crawl in the forest for a short distance and where one is sure to find various interesting things without much loss of time. Thus we accomplished the round trip to Panama in 30 hours. This morning while I write this letter it is again raining heavily.

Now, I can not tell how much I miss your company here not only for the sake of entomology but because you would immensely enjoy this fine bay where all sorts of native and American canoes, steam launches, sail boats have a fine time, where there is good bathing at least at high tide, where one can watch the working of the big stone crusher and the loading of the big iron barges which bring the crushed stone directly to the dam at Gatun.

The Canal Zone proper is a very tame looking country. Imagine the little clearing around our house in Cacao and you have here near every station the same vegetation a little back from the "cultivated" zone where there is nothing but well trimmed lawns with a few nut palms standing as ornament. There are hills everywhere all very steep. If there are no houses built up to the very top these hills are covered with the remnants of the old forest; every good-sized tree having been cut and the small trees now standing being probably the second growth. The smaller stations along the Canal are somewhat better off than the larger ones and each (at least as far as visited by me) has a peculiarity of its own. The country around Panama with its queer open savannahs and its narrow bands of shrubbery in the hollows radically differs from the rest of the Canal Zone; the northern end of the Zone nearly as far as Bohio is now a Lake and lost forever to natural history. The water of the lake is constantly rising and by the end of the year will extend as far as Gorgona.

Whatever wagon roads exist at present in the Zone run parallel or nearly parallel to the railroad. There are many trails running

back into the country but you have to walk them since no horses or mules can be had except through the quartermaster Department. If you have your baggage brought from the house you inhabit to the station you must apply to the Chief Quartermaster for an order; and to obtain this requires at least two days. In spite of all these drawbacks the Canal Zone can be easily explored entomologically but not within 4 or 5 months and if we two entomologists are expected to accomplish an entom. survey of the Zone within this time, it is simply an impossibility.

But it is here in the Porto Bello region that two or more entomologists can do only fragmentary work in 3 or four weeks. South of Colon the mountains along the coast gradually increase in height, the mountains back of Porto Bello being about 3000 feet, at any rate high enough to catch and precipitate the moisture from the Carribean. Consequently it rains here all the year around and the forest growth is just as exuberant as along the Rio Dolce. From what collecting we have done here it is evident that the insect fauna is enormously rich but difficult to get at. I think I wrote before of the absence of trails on the peninsula where the American settlement is but in the meantime I found that the trail from Old Porto Bello to Colon is an ideal place for collecting. This trail being hardly passable in former years is now being improved in consequence of considerable pressure exerted by the American authorities upon the State of Panama. It is said to be "improved" for about 5 or 6 miles out of Porto Bello but I have followed it up so far for only about one mile where it still leads up to the first mountain ranges. It is cut through the primaeval forest and there is excellent collecting not only along the trail itself but still better wherever there is an opening, such as a little creek, into the dark forest. The number of insects we have found on this trail is simply astonishing, but it is very difficult to find a good series of specimens of a given species excepting a number of species which are of universal distribution throughout this region.

I have to close this letter so that it goes with to-day's mail. Our health is first rate though I begin to feel a little disgusted with the monotony of the food furnished by the commissary.

A letter from the Washington Academy of Sciences inclosing a bill and forwarded to me reached me to-day. Best regards to all friends at the Office.

Yours sincerely,

E. A. SCHWARZ

P. S. Please address letters as usual: Paraiso, Hospital, I. C. Zone. We expect here to stay about two weeks longer.

I have not yet received any news from Washington about the two sets of boxes I mailed from the Isthmus.

U. S. National Museum, Washington, D. C.

February 8, 1912

Mr. H. C. Fall,
191 N. Raymond Ave.,
Pasadena, Cal.
Dear Mr. Fall:—

If you knew how much Mr. Barber and myself are occupied with the routine work on the Coleoptera of the Bureau of Entomology and at the National Museum you would certainly pardon me for not attending to your request.

Ever since my return from Panama last spring, official routine work has been accumulating on my desk. Since Dr. Howard has consented that correspondents all over the globe are allowed to send their material in Coleoptera here for naming, the work has grown upon me beyond my capability. I wish that yourself and other trustworthy N. A. Coleopterists that desire to study up the Museum material of Coleoptera would come to Washington and pick out the material themselves. In such cases all the Museum demands is that the rules pertaining to the loan of Museum material be adhered to. I understand that you have been in the east last summer; you did not come to Washington, where the work of picking out the *Pachybrachys* could have been accomplished within a few days. As I told you above both Mr. Barber and myself have our hands full of routine work and it is difficult to see how we can manage to pick out and prepare for transportation the enormous material we have in N. American *Pachybrachys* not to speak of the material we have from Central America. However that may be, I promise you that both Mr. Barber

and myself will make a determined effort to prepare our *Pachybrachys* at once.

I am no authority on Cuban beetles, but I determined most of those I secured on that Island as best as I could and if you send on Floridian material which may possibly be identical with Cuban species I shall gladly attend to their possible determination. I merely want to say that the tropical fauna of Florida is in many regards by no means identical with that of Cuba, and that one must look, in the identification of species, not only to other islands of the West Indies, but also to species described from Yucatan and the lowlands of eastern Mexico. A short trip made two years ago to Tampico, Mexico was a revelation to me and a lot of Coleoptera occurring there, both described and undescribed are identical with South Floridian species.

Very truly yours,
(Signed) E. A. SCHWARZ,
Custodian of Coleoptera.

The Jefferson,
Key West, Fla., March 6th, 1912

Dear Dr. Howard,

I greatly regret that, last Monday, owing to rheumatism and want of time, I neglected to call on you in order to thank you for your kindness in allowing me to go South. I arrived here at 4 P. M. to-day, the weather being for the present much colder than I hoped to find. They had a severe winter here and very few spring flowers are out. Shall try and find to-morrow what may be left of my old hunting grounds.

Hoping all is well with you I remain
Yours sincerely,
E. A. SCHWARZ

The Jefferson,
Key West, Fla.,
March 6th, 1912

Dear Barber,

I arrived here at 4 p. m., the train being 6 hours late. It was raining all the way through and it is still raining here at Key

West. Moreover it is much colder here than I expected (71°) so that one can see many overcoats on the muddy streets.

The railroad trip across the Keys is of course mighty interesting. The road is certainly one of the most remarkable engineering feats ever attempted; still I would decline to travel over it during a good West Indian hurricane. Its construction has been disastrous to a goodly portion of the hammock and brush lands of the Keys; for the workmen or the engineers cut down every tree and shrub in a wide belt on either side of the track; I suppose in order to protect themselves against mosquitoes. Moreover there are at present no stations on the Keys; the only one being on Long Key, and this is a fishing camp, the island itself having no vegetation whatever excepting a few coconut trees.

It rains so heavy that I could not get out to see what kind of souvenir cards they have at this place.

Yours sincerely,
E. A. SCHWARZ

Key West, Fla., March 8, 1912

Dear Dr. Howard,

I am greatly obliged to you for sending me stationery, boxes, etc., all of which came to hand this afternoon.

It rained here yesterday (March 7th) nearly the whole day but late in the afternoon I took a carriage and drove over the island to look at the devastation of the native flora and fauna brought about lately by Mr. Flagler's "improvements." Magnificent boulevards extend now all over the island but unfortunately also right across my old hunting grounds so that there is very little left of the old shrubbery. To-day being beautifully warm and bright I started on my first excursion being out nearly four hours and walking about four miles. I was quite exhausted when I came back but found that at least a portion of the Key West fauna is still in existence. Within two years, however, no trace of it will be left. I hope and feel confident that this warm weather and the exercise will do me good.

Yours sincerely,
E. A. SCHWARZ

The Jefferson,
Key West, Fla.,
March 8th, 1912.

Dear Barber,

Many thanks for the boxes etc. you sent me and which came to hand this afternoon. Yesterday it continued to rain until 3 o'cl. p. m., but then I took a carriage and drove over this island to see what is left of my old hunting ground. To be sure there is not much left, the best part, i.e., the most elevated spots being converted into building lots, and broad boulevards cross the whole width and length of the island. To-day being warm and bright I ventured out on my first excursion and managed to be more than four hours in the brush. At least a portion of the Key West fauna is still left although many species, formerly common, seem to have become extinct, e.g., all the Cryptorhynchidae and many other weevils. I came home quite exhausted but recovered soon so that just now I have returned from an inspection of the electric lights of the town. This morning I got a fine Xylophilus which is new to our collection but strange to say I did not see a single Thrips. Tell Mr. Hood that the *Ficus indica* trees upon which in former years I saw millions of a gall-making thrips, have disappeared. I perspired freely during my excursion and I think this did me good.

Yours sincerely,
E. A. Schwarz

The Jefferson,
Key West, Fla.,
March 16, 1912

Dear Barber,

I have your two most welcome cards of March 11th and March 12th resp. Glad to hear that the Entomol. meeting went off all right; if I had been there, there would have been 36 persons present but there would not have been a wastage of lager beer.

. . .

Besides writing you on the 6th and 8th I sent you two cards on the 11th. I also sent to Dr. Howard 6 packages of which 3 contain Scolytid galleries and these I requested Dr. Howard to

turn over to Dr. Hopkins. The remaining three packages I requested to be turned over to you. There is not much of important material in them: in the pill boxes are not many specimens but some very good species. I was greatly surprised to find here the Ptinid genus Pitnus which was hitherto known only from Central America and Lower California, and greatly wonder whether the Key West species is different. All these specimens pasted in pill boxes can remain as they are until I come home but I am anxious that you make an effort to have determined the two plants viz. ?Ilex and ?Piscicidium. The specimens in the small alcoholic vials also do not need to be worked up but they should be put into a larger vial filled with alcohol. The living material is of very little consequence.

The weather has been fair and very warm here since last week but yesterday night a most violent rain storm broke over this island, flooding the entire town, and more rain is sure to come to-day. Fortunately there is no cold wave in sight and the temperature continues to be high.

On my first excursion here I got of course badly sunburnt and also acquired a very pronounced case of Neotrombidiosis. Mosquitoes (only two species of Culex and a rare Anopheles) are not very troublesome but there are millions of houseflies. No ticks here in spite of the many cattle.

I have been in the field every day for 4 or 5 hours but I take it easy and often rest during excursions. My health has improved in many ways, and only one thing will not get better, viz., the dumb pain across my chest which as I see now has no connection with rheumatism. This annoys me a great deal since it renders me unfit for any serious entomological field work and it would be foolish for me to extend this trip further South unless conditions change. So I have made up my mind to stay here for a week longer and wait for improvements.

The death of Dr. J. B. Smith, although not unexpected by me, affects me a great deal. I have known him for the last 38 years and we were always good friends. I think our Entom. Society should take some action in this matter.

I have again forgotten the initials of McAtee, Myers and the rest of the boys. Souvenir cards are of very poor quality here

in spite of the most beautiful marine scenery to be seen on all sides.

The restaurant attached to the Jefferson Hotel (the only decent one in the town) shut down for the summer the very first day I arrived here, and I take my meals in a Cuban restaurant where I enjoy Frijoles con arroz (just as in Cacao, Guatemala), Huevos fritos en plata, besides excellent fresh fish. The supply of fresh vegetables and fruits is very limited here but we have an abundance of ripe tomatoes and strawberries (these of course from Cuba).

Please give my best regards to all the boys in the Office.

I am closely watching the meteorological conditions in the North but can do it only by means of reading the New York Herald which we get here two days late.

Yours very sincerely,

E. A. SCHWARZ

Key West, Fla. March 17, 1912

To accompany Package No. 7

Dear Dr. Howard,

During the December, 1911, meeting of the Economic Entomologists there was a great deal of talk of Thrips and Thrips parasites. This reminded me of the "Laurel" Thrips of Cuba and Key West which occurs on the trees it infests in incredible number of specimens. Many years ago I sent specimens from Key West to the old Division of Entomology but I was never informed what species it is, nor did I ever find out what has been done with these specimens.

To-day I came across an infested tree which harbors many millions of specimens of this Thrips, each pseudogall containing several hundred specimens. The tree is a valuable shade tree and looks very badly when heavily infested.

Each pseudogall contains a few old, winged specimens, any number of immature specimens and any number of what may be the eggs.

I should not wonder if parasites could be bred from this species.

The tree is *Ficus indica* and the famous Prado in Habana is lined with them throughout its entire extent.

I suppose that Prof. Quaintance is the proper man to get this package.

Yours sincerely,
E. A. SCHWARZ

P. S. The box I sent contains only a small fraction of the galls that can be seen on a small branch.

U. S. National Museum,
Washington, D. C.
May 15, 1913

Dear Prof. Fall:—

I most cordially thank you for having sent to me an author's extra of your *Magdalis* paper. I glanced it over and it is certainly a good one. I am sorry that in the biological notes you omitted Hubbard's paper published in the first volume of Psyche, on the species affecting *Ulmus*.

I wonder, that in describing your genus *Trichomagdalis,* you failed to compare it with the genus *Carcilia* Roelofs. I think these two genera are synonyms, although we have no examples of species of this genus from Japan for comparison. I called Mr. Pierce's attention to this fact and after looking over the matter he participates in this opinion. The rest of your paper I have not looked into very carefully. I am interested in the synonymical remarks you have made but I feel awfully sorry for anyone that will take up a thorough study of our Anthonomini in view of the large number of isolated species that have been described since the publication of Mr. Dietz's synopsis.

Hoping that you are well or at any rate better off than myself, because I managed three weeks ago to break my collar bone. Mr. Barber sends also his regards and thanks for the copy of the paper you had sent to him.

Very sincerely,
(Signed) E. A. SCHWARZ
Cust. of Coleop.

Prof. H. C. Fall,
191 N. Raymond Ave.,
Pasadena, Calif.

Tucson, Ariz., November 29th, 1913

Dear Dr. Howard,

It is not my intention to trouble you with a long letter. It suffices to say that Barber and myself have gone to work without

delay since our arrival at Tucson last Tuesday. We have visited Ventana Canyon and Sabina Canyon in the Catalina Mts, and the Sierrita Mts, some 30 miles southwest of Tucson and near the Baboquivari Range. To-day Barber has gone alone on horseback to Pima Canyon while I had to attend to the financial side of this trip. To-morrow (Sunday) will be an expedition, with Prof. Thurnber, to the Rincon Mts.

The weather has been very fine so far: very cold in the morning and evening, and beautifully warm during midday. The greatest drawbacks of this Expedition are: the shortness of the days; the great distances to be travelled in one day to reach the mountains; and the want of any accommodations in or near the mountains. The city of Tucson is the only available base in this part of the State from which mountain expeditions can be made and it is more than 15 miles distant from the nearest canyon.

It is too early to say whether or not our observations and information obtained on this trip will be of value. At any rate, Mr. Barber works with admirable energy and endurance, while I find myself unable, on account of old age, to do heavy mountain climbing, especially if such work has to be done in a hurry in order to get back to our wagon or automobile in a stated time.

Our living expenses are very moderate and we are also tolerably well housed, but wagons and especially autos are extremely expensive; for instance the auto to Sabina canyon (about 35 miles going and return) cost $15.00 a day.

Prof. Thurnber is a splendid man and always willing to help us along; fortunately for us he is only too glad to accompany us on our trips whenever he can get away from his University duties.

Tucson has enormously improved since Hubbard and myself were here in 1898; the irrigated district in the immediate vicinity of the city has disappeared to make room for a new depot (the Nogales R. R.) and for real estate blocks, and the danger of being overrun by an auto while crossing the street is much greater than in Washington.

After a careful calculation I find that our money will be gone before we are through with even a part of our intended work,

and I beg of you therefore to hand the enclosed note to Mr. Clifton.

Hoping that these lines will find yourself, your family, and everyone in the office in good health I remain

Yours sincerely,
E. A. SCHWARZ

Tucson, Ariz. December 1st, 1913

Dear Dr. Howard,

I wrote you a letter on November 29th. On the same day Mr. Barber went up to Pima Canyon (which, by the way is only about 9 miles distant) and reported an interesting excursion among the Thurberias. Yesterday (Sunday) we made a big excursion, in company of Prof. Thurnber and one of his students to the Rimon Mts., about 30 miles southeast of Tucson. Although we had a powerful auto and started at an early hour, the day was altogether too short since it is absolutely necessary to go over the bad part of the road during the day light. Still Prof. Thurnber and Mr. Barber climbed up the mountain to an altitude of about 500 feet, reaching the upper limit of the Thurberias. During this very cold day we had rain and snow but returned to Tucson safely though very tired and considerably shaken up. As usual I dropped behind and did not reach the Thurberias but did some general collecting on the way.

To-day the weather is again very cold and we are packing specimens and rearranging baggage for a 3 days trip to the Santa Rita Mts.

We are both in good health.

Yours sincerely,
E. A. SCHWARZ.

P. S. Mr. Barber attends to the sending of packages with explanatory notes.

E. A. S.

U. S. National Museum. Washington, D. C.,
October 15, 1914

Dear Prof. Fall,

I most sincerely regret that there has been so great delay in my reply to your most welcome letter of September 19th, but it

reached me in the midst of a very severe attack of asthma which unfortunately continues.

Glad to hear that you have not abandoned your work on Pachybrachis. I knew that it would prove to be a hard job, and admire your courage in undertaking it.

I have spent some time in bibliographic researches regarding the authorship of Pachybrachis and enclosed I send you the necessary citations. The result is as follows:

If you are a follower of the modern rules of nomenclature you must use ''Pachybrachis'' Chevrolat and quote as the original date and place of publication Dejean's Catalogue 3rd. edition, 1834 or 1836. According to these rules a generic name is to be recognized as valid, even if it is not accompanied by a description, as long as it includes species described by previous authors (f. i. Fabricius, Olivier etc.). If you belong to that school of zoologists which does not follow these rules in their strictest sense you have to write Pachybrachys Suffrian and quote the year 1847 as the correct date. Redtenbacher's name Pachybrachys has no standing whatever, and it is quite astonishing to see that he is still followed by some recent writers f. i. Everts. I am afraid that, in order not to incur the ire of Dr. Stiles and the other members of the International Committee on Zool. Nomenclature, we have to write *Pachybrachis* Chevrolat.

The type of this genus has, as far as I know, never been designated but should no doubt be *P. hieroglyphicus* Laich. which is the most common and best known European species and which has a definite food-plant (Salix).

The American species of Pachybrachis are so troublesome because most of our Eastern species, and apparently also many of our western ones, do not appear to have any definite food-plant in the imago state and because their larvae (which unquestionably are all sac-bearers) are so difficult to find and do not feed upon the foliage of plants. In fact Mr. Barber and myself have bred only a single species, *P. tridens* from larvae found crawling under old leaves on the ground. The imago of *P. tridens* is also the only eastern species which seems to have a definite food plant viz. *Rhus toxicodendron*. Some of the larger species found by Barber & Schwarz at Williams, Ariz. occurred exclusively on

Pinus engelmanni and some of the smaller species from the desert region of Arizona have also definite food-plants but I failed to obtain the names of these plants from the poor specimens I gathered.

There are no biological notes on this genus at the Bureau of Entomology in Washington, none of the species having ever acquired an economic importance.

You may have possibly overlooked a synonymical note by Weise in Wiener Entomol. Zeitung., vol. 32, July, 1913, p. 219 where he changed the name *Pachybrachys elegans* Blatchley (preoccupied by P. elegans Graells) to *P. praeclarus* Weise.

The use of the name *Scolochrus* Suffr. for *Griburius* Haldeman is to be rejected by all means. The French name ''le gribouri'' which is now the popular name for *Adoxus vitus* in France can not be found in any of the French dictionaries in common use, and I fail to understand the meaning of Chapuis' remarks in Lacordaire's ''Genera,'' vol. X, page 167 (foot note) but it is possible that the name has some obscene meaning. Suffrian changes the name purely for philological reasons. Griburius is just as good a name as Horn's genus *Pemalus* or Casey's *Pappusus* or many other generic names.

I send you herewith a copy of Roelof's description of the Curculionid genus Carcilia which I made for you many months ago. The genus must be very close to your *Trichomagdalis* but we have no species among our Japanese material.

I have some difficulty in writing with my lame hands but I hope you will be able to make out the larger portion of this long letter.

Yours very sincerely,
E. A. SCHWARZ

Washington, D. C. October 29, 1914

Dear Prof. Fall,

If I were in your place I would also use a little common sense instead of following the iron-clad rules of Nomenclature and write *Pachybrachys* Chevrolat in the same way as Dr. Leconte has done. By the way I notice that in Melsheimer's Catalogue of N. A. Coleoptera (1853) which has been edited by Haldeman and

Leconte the queer combination of Pachybrachis Suffrian is used. In the same Catalogue, p. 127 (footnote) there are some remarks by the Editors against the substitution of *Scolochrus* for *Griburicus.*

On the enclosed Slip 1 I send you a copy of Graell's description of *Pachybrachys elegans* with quotation. Weise's change of name is to be followed. This reminds me of the fact (probably not overlooked by you) that the name of *Pachybrachys limbatus* Newman (1840) is to be changed on account of *P. limbatus* Ménétries (1836 and 1838).

I see that I was not careful enough in my quotation of Suffrian's remarks in Linnaea Entomol. vol. II, 1847, p. 5 (continued on p. 6) and I enclose a copy thereof on Slip 2. Suffrian is certainly somewhat obscure in his remarks but had I continued reading up to p. 8 I would have seen that Suffrian understands his genus Stylosomus as the Cryptocephali without scutellum. On this p. 8 he gives a concise table of the European Cryptocephali (see enclosed copy on Slip 3) from which it is evident that he established the genus Pachybrachys in 1847 and not in 1848 as it is universally quoted.

Yours sincerely,

E. A. SCHWARZ

Mr. Charles W. Leng, although unable to submit any letters from Mr. Schwarz for this collection, was the happy recipient of some of the latest of Dr. Schwarz's written communications relating to Coleoptera in the form of notes and comments given on the galley proofs of the Leng Catalogue of Coleoptera of America, North of Mexico, published 1920. Just a few of these remarks, which covered every imaginable feature of the work, are given below.

Silpha truncata Say 23–193.—This is the type of the genus Philas Portevin 1903. Bull. Mus. d'hist. nat. Paris p. 331. The genus is a good one and should by all means be recognized.

Silpha surinamensis Fab.—belongs to Necrodes Leach.

Silpha lapponica Hbst.—belongs to Thanatophilus Samouelle 1819.

Silpha opaca L.—This is the type of Reitter's genus Blitophaga.

Colon elongatum Notman 19–98—is omitted. [Included in "Supplement."]

Ababa tantillus (Lec.) 65–96.—Type locality is Washington, D. C. Who found it in Mass.?

Attention is called to the omission of Leconte's Synopsis of Mordellidae 1862. pp. 43–51.

The entire family Euglenidae should be changed: since neither the genus Euglenus nor Aderus occur in N. A. the only way to give a catalogue of our species is to recognize Casey's genera as good from Elonus to Axylophilus and to omit Euglenus with synonyms you give and put

8510 nucleus (Fall)
8511 constrictus (Fall)

described as Xylophilus, which has lost its standing, under line preceding Cnopus.

The three forms of *Anthaxia* (*californica, pennsylvanica,* and *caseyi*) described by Obenberger, Ent. Blatt. 1914, pp. 25–26 should be brought in as unrecognized species at end of genus. They are probably all synonyms or at best varieties.

Hemipeplus microphthalmus Sz. 78–360 is quite distinct from *H. marginipennis* Lec. See Casey, Revision of Cucujidae, 1884, p. 101.

Hapalips texanus Schfr. belongs to Cryptophagidae, not Erotylidae. See Champion, Trans. Ent. Soc. London, 1913, p. 96.

Emmenastus rugosus Mots.—Mannerheim, Dritten Nachtrag zur kafer fauna, etc. 1853, p. 112, states that he has seen the type of Motschulsky's genus Emmenastus and states that it is nothing else but Blapstinus, the species being close to (and perhaps identical with) *Bl. pulverulentus* Esch. The genus should be listed as a synonym of Blapstinus. The sequence of genera of Bostrychidae as given by Lesne should be followed.

Endecatomus reticulatus (Hbst.) and *E. rugosus* (Rand.) are certainly not Bostrichids.

The various unrecognized species of Mylabris described by Motschulsky from Georgia have all to be omitted. The Georgia of Motschulsky is not in the U. S. but is a province of Russia now known as Transcaucasia.

Trachodes horridus Mann. 52–354 from Alaska, Vanc. belong to genus Aparapion Hampe, 61–63. See L. von Heyden D.E.Z. 1879, Vol. 23, p. 167.

Nanophyes pallidulus (Grav.) Eur. N. J. La. Colo? Found by myself at Alamosa, Colo, E.A.S.

Centrinus Schon. 26–308. Change to Geraeus Pascoe, 89–322 (Centrinus auct.).

At the close of the preface to his Catalogue Mr. Leng says: "Mr. Schwarz with his life-long study of the Coleoptera, his retentive memory, and his devotion to science, a devotion so great that it makes no task unwelcome in its service, has taken such a capable interest in the work that in succession, the manuscript, the galley proof, and page proof, have passed through his erudite and kindly criticism. His corrections are often specially acknowledged in footnotes, but no acknowledgment can fully convey the feeling of admiration and affection his help has aroused."

These sentiments of Mr. Leng and those expressed by Dr. Howard and others in Proceedings Washington Entomological Society, Vol. 30, No. 9 for December, 1928, are shared by everyone who had the good fortune to come into contact with this unique, wonderful and lovable being, Eugene Amandus Schwarz.

The Jefferson

KEY WEST, FLA., March 6th 1912

Dear Barber,

I arrived here at 4 p.m., the train being 6 hours late. It was raining all the way through and it is still raining here at Key West. Moreover it is much colder here than I expected (71°) so that one can see many overcoats on the muddy streets.

The railroad trip across the Keys is of course mighty interesting. The road is certainly one of the most remarkable engineering feats ever attempted; still I would decline to travel over it during a good West Indian hurricane. Its construction has been disastrous to a goodly portion of the hammock and brush lands of the Keys; for the workmen or the engineers cut down every tree and shrub in a wide belt on either side of the track, I suppose in order to protect themselves against the mosquitoes. Moreover there are at present no stations on the Keys, the only one being on Long Key, and this is a fishing camp, the island itself having no vegetation whatever excepting a few Cocoanut trees.

It rains so heavy that I could not get out to see what kind of souvenir cards they have at this place.

Yours sincerely,
E. A. Schwarz

Vol. XXXVII December, 1929 No. 4

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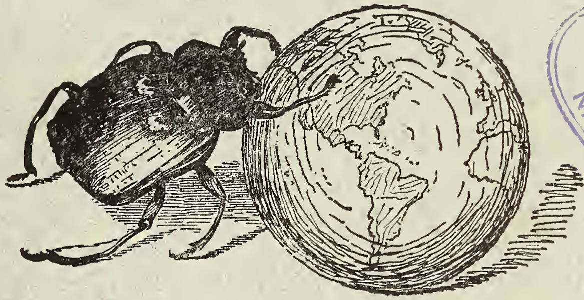

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Edited by HARRY B. WEISS

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JOURNAL

OF THE

New York Entomological Society

Vol. XXXVII December, 1929 No. 4

RECORDS AND DESCRIPTIONS OF NEOTROPICAL CRANE-FLIES (TIPULIDÆ, DIPTERA), VII

By Charles P. Alexander

Amherst, Mass.

The preceding part under this general title was published in 1929 (Journal N. Y. Entomological Society, 37: 89–99). The majority of the species and subspecies discussed at this time are from Paraguay, where they were collected chiefly by my friend, Mr. Friedrich Schade. The other species were taken in Brazil by Parish; Trinidad by Withycombe; Jamaica by Gowdey; and Cuba by Messrs. Acuña, Myers and Salt. The types of the new species are preserved in my collection through the great kindness of the collectors, that of the new *Erioptera* from Trinidad being in the British Museum of Natural History.

Genus *Limonia* Meigen

Limonia (Geranomyia) antillarum, new species.

Closely allied to *L.* (*G.*) *rostrata* (Say), differing especially in the larger size, subterminal darkened rings on femora, narrow wings with slightly different venation and pattern, and the details of the male hypopygium.

Male.—Length (excluding rostrum) about 7.5 mm.; wing 7.6 mm.; rostrum about 3 mm.

Female.—Length (excluding rostrum) about 8–9 mm.; wing 7.3–8 mm.; rostrum about 3.2–4 mm.

Rostrum black, the extreme apex of the labial palpi paler. Antennæ brownish black, the flagellum paler, especially outwardly. Head light gray, the posterior vertex brownish gray, split by a capillary line of the ground-color.

Mesonotal præscutum chiefly occupied by four brownish gray to gray stripes, the lateral stripes usually clearer gray, the interspaces brown to black; humeral region obscure yellow; scutal lobes gray; scutellum brownish testaceous; postnotum dark, heavily pruinose. Pleura buffy-gray, variegated with dark brown, including a spot on the anterior anepisternum; sternopleurite darkened, pruinose. Halteres pale yellow, the knobs blackened. Legs with the coxæ and trochanters light yellow; femora yellow, with a broad dark brown ring shortly before the tips; tibiæ obscure yellow, the tips broadly blackened, of the fore tibiæ slightly dilated and more intensely blackened; tarsi brownish yellow, the outer segments infuscated. Wings relatively long and narrow, subhyaline, with a dark brown pattern that is arranged much as in *rostrata* but differs in degree and position of certain of the spots; area over origin of *Rs* narrow, oblique, the proximal end lying over the end of *Sc*; stigmal area shallow, its posterior edge not or but slightly passing vein R_{2+3}. Venation: *Sc* short, Sc_1 ending before the origin of *Rs*, Sc_2 at its extreme tip; a supernumerary crossvein in cell *Sc*; *m–cu* before or close to fork of *M*, in the latter case nearly in alignment with the basal section of M_{1+2}.

Abdomen dark brown to pale brown, in the latter case the bases of the segments narrowly ringed with dark brown; caudal margins of the segments narrowly pale. Male hypopygium with the spines of the rostral prolongation of the ventral dististyle longer than in *rostrata*.

Habitat.—Greater Antilles.

Holotype, ♂, Soledad, Cuba, February 20, 1925 (J. G. Myers).

Allotopotype, ♀.

Paratopotypes, 3 ♂ ♀, March 6–12, 1925 (J. G. Myers); paratypes, 1 ♀, Güinas, Cuba, April 22, 1925 (Geo. Salt); 1 ♀, Plantain Garden, Jamaica, November 12, 1926 (C. C. Gowdey); 1 ♀, Hope Gardens, Jamaica, January 3, 1926 (M. C. Gowdey).

The species has been recorded from Jamaica as *rostrata* (Alexander, Dept. Sci. and Agr. Jamaica, Ent. Bull. 4: 22; 1928). It is likewise undoubtedly the same fly that was recorded under this same name from Cuba by Osten Sacken (Mon. Dipt. North America, 4: 79–80; 1869).

Limonia (Geranomyia) cubana, new species.

Allied to *L.* (*G.*) *rostrata* (Say); rostrum relatively short; femoral tips darkened; wing-pattern more diffuse; cell *1st* M_2 elongate, exceeding the veins beyond it.

FEMALE.—Length (excluding rostrum) about 9 mm.; wing 7.5 mm.; rostrum about 2.3 mm.

Rostrum relatively short, as shown by the measurements, black, the tips of the labial palpi a trifle paler. Antennæ brownish black throughout;

flagellar segments oval, the terminal segment exceeding the penultimate. Head light gray, the posterior vertex chiefly brownish gray, divided by a pale median vitta.

Mesonotal præscutum with the stripes light brown, the interspaces darker brown, the humeral region somewhat brighter; scutellum pale; postnotum light plumbeous gray. Pleura chiefly brownish yellow. Halteres pale, the knobs brownish black. Legs with the coxæ and trochanters pale yellow; femora testaceous yellow, the tips broadly and conspicuously dark brown; tibiæ brownish yellow, the tips conspicuously blackened, of the fore tibiæ clavate and more intensely black; tarsi pale brown, the outer segments darker. Wings with a faint brown suffusion, the brown pattern paler than in allied species, more diffuse, arranged about as in *rostrata;* area at origin of *Rs* large, roughly oval. Venation: Sc_1 ending shortly beyond the origin of *Rs*; a supernumerary crossvein in cell *Sc*; cell *1st* M_2 elongate, exceeding the veins beyond it; *m–cu* at fork of *M*.

Abdominal tergites brownish yellow, variegated with darker, especially basally; sternites clearer yellow. Ovipositor with the valves yellowish horn-color, the base of the tergal valves narrowly darkened; tergal valves slender and straight.

Habitat.—Cuba.

Holotype, ♀, Hanabanilla Falls, April 7, 1925 (J. G. Myers).

Limonia (*Geranomyia*) *cubana* is allied to *rostrata* (Say) and *antillarum*, new species, differing especially in the shorter rostrum, darkened femoral tips, and the wing-pattern. There can be little question but that *tibialis* (Loew) is likewise closely allied, despite the unpatterned wings.

Limonia (Geranomyia) myersiana, new species.

General coloration pale brown; mesonotal præscutum with three narrow pale brown stripes; tips of fore tibiæ conspicuously blackened; wings subhyaline, unmarked except for the oval pale brown stigma; *Sc* short, Sc_1 ending opposite the origin of *Rs*; male hypopygium with the mesal apical lobe of the gonapophysis slender, gently curved, the outer edge bearing a small flange.

MALE.—Length (excluding rostrum) about 4 mm.; wing 5.3 mm.; rostrum about 2.3 mm.

Rostrum relatively elongate, exceeding one-half the remainder of the body, brownish black, the labial palpi paler at tips. Antennæ dark brown, the flagellum paler brown; flagellar segments oval. Head chiefly dark brown.

Mesonotal præscutum obscure yellow, with three narrow pale brown stripes. Pleura obscure yellow. Halteres short, dusky, the extreme base of the stem yellow. Legs with the coxæ and trochanters pale yellow; femora yellowish brown, the tips scarcely darkened; fore tibiæ obscure

brownish yellow, the tips broadly blackened, of the other tibiæ only narrowly and vaguely infuscated; tarsi short, pale brown. Wings subhyaline, the oval stigma pale brown; veins brown. Venation: *Sc* unusually short, Sc_1 ending opposite the origin of *Rs*, Sc_2 at its tip and before this origin; *Rs* elongate, more than three times the basal section of R_{4+5}; *m–cu* before the fork of *M*, shorter than the distal section of Cu_1.

Abdomen light brown, the hypopygium somewhat brighter. Male hypopygium with the tergite transverse, the caudal margin with a narrow V-shaped median notch. Ventral dististyle large and fleshy, the rostral prolongation unusually short, less than either rostral spine; spines arising from small subequal tubercles, nearly straight and approximately equal in size. Gonapophyses with the mesal apical lobe slender, dusky, gently curved, on outer edge with a small flange.

Habita.—Cuba.

Holotype, ♂, Hanabanilla Falls, April 7, 1925 (J. G. Myers).

Most similar to *L.* (*G.*) *tibialis* (Loew), differing especially in the structure of the male hypopygium. The latter species has the rostral spines unusually long and slender, exceeding twice the prolongation itself; dorsal dististyle short and broad; and gonapophyses conspicuously bifid at tips.

Limonia (Geranomyia) biargentata, new species.

General coloration of mesonotal præscutum brownish yellow, with a narrow sublateral silvery line on either side; femora with a narrow subterminal brown ring some distance before tip; wings brownish yellow, with a sparse brown pattern that is chiefly costal in distribution; *Sc* ending beyond midlength of *Rs*; male hypopygium with the spines of the rostral prolongation of the ventral dististyle straight, arising from small basal tubercles; gonapophyses with the mesal apical lobe a small blackened point.

MALE.—Length (excluding rostrum) about 4.5 mm.; wing 5–5.2 mm.; rostrum about 2.5–2.6 mm.

Rostrum relatively elongate, black, paling to brown on outer half. Antennal scape black, the flagellum much paler, brownish yellow; flagellar segments long-oval. Head light gray, the posterior vertex with a blackish triangle on either side of a capillary median vitta.

Pronotum brownish black, lined laterally with gray. Mesonotal præscutum light brownish yellow to reddish yellow, with a narrow sublateral silvery line, very distinct when viewed from above; scutal lobes yellow, the mesal edge narrowly lined with dusky, the median area of scutum narrowly silvery, the color extended caudad onto the scutellum, the remainder of the latter infuscated; postnotum plumbeous brown. Pleura chiefly pale brownish yellow. Halteres pale, the knobs infuscated. Legs with the coxæ and trochanters pale yellow; femora yellow, with a narrow brown ring that is placed more than twice its own length before apex;

remainder of legs chiefly yellow, the tips passing into dark brown. Wings with a faint brownish yellow tinge, the oval stigma pale brown; three smaller but somewhat darker brown spots in the subcostal field, the second at origin of *Rs*, the third at fork of *Sc;* very vague dusky seams along cord and outer end of cell *1st* M_2; veins pale brown, *Sc*, *R* and *Cu* brighter. Venation: Sc_1 ending shortly beyond midlength of *Rs*, Sc_2 not far from its tip; *Rs* weakly angulated at origin; *m–cu* at fork of *M*, subequal to the distal section of Cu_1.

Abdomen brownish yellow, the sternites clearer yellow. Male hypopygium with the caudal margin of the tergite conspicuously notched, the lateral lobes conspicuous, rounded. Rostral prolongation of ventral dististyle relatively long and slender, the two spines nearly straight, the inner a trifle longer, both arising from subequal small basal tubercles. Dorsal dististyle a slender, curved rod, the tip acutely pointed. Gonapophyses with the mesal apical lobe a small blackened point that is subequal in length but more acute than the lateral lobes, the two separated by a circular notch. Ædeagus unusually narrow.

Habitat.—Paraguay.

Holotype, ♂, Villarica, November 5, 1924 (F. Schade).

Paratopotype, ♂, June 10, 1925 (F. Schade).

Limonia (*Geranomyia*) *biargentata* is generally similar to *bicincta* (Alexander) in the coloration of the præscutum, differing most evidently in the structure of the male hypopygium, especially in the narrow ædeagus and unusually small spinous mesal apical lobes of the gonapophyses.

Limonia (Geranomyia) lemniscata, new species.

MALE.—Length (excluding rostrum) about 5.5 mm.; wing 6.2 mm.; rostrum about 2.8 mm.

Closely allied and generally similar to *L.* (*G.*) *biargentata* new species, in the coloration, differing especially in the larger size and structure of the male hypopygium.

Rostrum with the base blackened, the distal four-fifths paler. Antennal scape black, the flagellum brownish yellow. Silvery lines on the præscutum and median region of scutum and scutellum very distinct. Wings with *Rs* longer; cell *2nd A* wider. Male hypopygium with the tergite transverse, the caudal margin gently emarginate, the lateral lobes low, conspicuously setiferous. Ventral dististyle with the rostral prolongation of moderate length, the two spines separated, arising from short, subequal basal tubercles; outer spine a little shorter than the inner, both straight and slender; inner spine placed at extreme base of prolongation. Dorsal dististyle relatively stout, gently curved, the tip narrowed into an acute, somewhat decurved point. Gonapophyses with the mesal apical lobe very broad and conspicuous, gradually narrowed into a darkened point, the edge of notch microscopically serrulate. Ædeagus wider than in *biargentata*.

Habitat.—Paraguay.

Holotype, ♂, Santa Barbara, October 10, 1925 (F. Schade).

Limonia (Geranomyia) villaricensis, new species.

General coloration obscure yellow, variegated with darker; mesonotal præscutum with a median brownish black stripe, the lateral stripes reddish brown, all stripes separated by narrow silvery vittæ; femora with a narrow subterminal brown ring; wings grayish yellow, with a restricted dark pattern; *Sc* long, Sc_1 ending about opposite five-sixths the length of *Rs*; male hypopygium with the rostral spines of the ventral dististyle of moderate length, straight, closely approximated on a short basal tubercle; gonapophyses blackened, the mesal apical lobe a short blackened spine.

MALE.—Length (excluding rostrum) about 7 mm.; wing 7.5 mm.; rostrum about 4 mm.

Rostrum relatively elongate, exceeding half the length of the body, the base blackened, the distal portion paler; palpi black. Antennæ with the scape brownish black, the flagellum obscure brownish yellow, the outer segments darker; flagellar segments long-oval. Head gray, the posterior vertex with a blackish triangular area on either side of a capillary median vitta of the ground-color.

Pronotum pale, tri-lineate with brownish black. Mesonotal præscutum reddish brown, handsomely lined with silvery gray and brownish black; a median brownish black stripe, conspicuously darker than the reddish brown lateral stripes; four silvery gray lines divide the three stripes from one another and from the lateral margin; scutal lobes brownish yellow, the mesal edge of each darker; a silvery median line extends from the suture onto the scutellum, the latter otherwise brownish yellow; postnotal mediotergite brownish yellow, more or less pruinose. Pleura yellowish testaceous, more or less pruinose, the sternopleurite more plumbeous. Halteres yellow, the knobs infuscated. Legs with the coxæ and trochanters yellow; femora yellow, with a subterminal dark brown ring that is subequal to or slightly shorter than the yellow apex; tibiæ and tarsi obscure yellow, the outer tarsal segments darker. Wings grayish yellow, with a restricted darker pattern; cell *Sc* clearer yellow; a series of four brown spots in cell *Sc*, the third at origin of *Rs*, the fourth at the fork of this vein; stigma oval, paler brown; narrow and inconspicuous seams along cord and outer end of cell *1st* M_2; veins pale brown, *C*, *Sc*, *R* and *Cu* more yellowish. Venation: *Sc* long, Sc_1 ending about opposite five-sixths the length of *Rs*, Sc_2 at its tip; a supernumerary crossvein in cell *Sc*; cell *1st* M_2 large and ample; *m–cu* just beyond the fork of *M*, longer than the distal section of Cu_1.

Abdominal tergites brownish yellow, darker laterally; sternites obscure yellow. Male hypopygium with the tergite transverse, the caudal margin gently emarginate. Basistyle relatively long, the ventro-mesal lobe conspicuous. Ventral dististyle large and fleshy, the rostral prolongation short but conspicuous, constricted basad of the spines; the latter arise close together at near midlength of the prolongation, apparently from a single

short tubercle and are straight and subequal. Dorsal dististyle a slender, gently curved rod, the tip narrowed into a long spine. Gonapophyses heavily blackened, compact, the mesal apical lobe a blackened conical spine.

Habitat.—Paraguay.

Holotype, ♂, Villarica, October 14, 1925 (F. Schade).

The closest regional ally of the present species appears to be *L.* (*G.*) *bicincta* (Alexander), which differs especially in the structure of the male hypopygium.

Limonia (Geranomyia) inaequituberculata, new species.

Mesonotal præscutum reddish yellow, with three narrow velvety black stripes that are separated by capillary buffy lines; pleura testaceous yellow; femora with the apex broadly yellow, enclosing a narrow black subterminal ring; wings with a restricted dark pattern; male hypopygium with the spines of the rostral prolongation of the ventral dististyle long, arising from very unequal basal tubercles, the prolongation beyond this point being long and slender.

MALE.—Length (excluding rostrum) about 5.5–5.8 mm.; wing 6–6.5 mm.; rostrum about 2.8–3 mm.

Rostrum, including the labial palpi, black, the intermediate portion of the latter paler. Antennæ with the basal segments black, the flagellum paler, more brownish. Head dark gray, the posterior vertex with two linear velvety black lines that are separated by a capillary gray median vitta.

Mesonotal præscutum reddish yellow, with three narrow velvety black stripes that are separated only by narrow buffy lines; median stripe broadest, the closely approximated laterals narrow, only a little wider than the pale interspaces; scutum light brown, the mesal portions of the scutal lobes darker; a narrow median silvery vitta extends from the suture to the end of the scutellum; remainder of scutellum infuscated; postnotal mediotergite with the median region dark brown, the lateral portions paler. Pleura testaceous yellow, the dorso-pleural region vaguely more dusky. Halteres yellow, the knobs infuscated. Legs with the coxæ and trochanters yellowish testaceous; femora brownish yellow, somewhat brighter yellow basally, the distal end clearer yellow, enclosing a brownish black ring that is about twice as wide as the yellow apex and subequal to the yellow subterminal ring; tibiæ brownish yellow, the tips narrowly infuscated; tarsi obscure yellow, the outer segments blackened. Wings grayish yellow, cell *Sc* clearer yellow; a sparse brown pattern, including a common cloud that encloses the origin of *Rs* and fork of *Sc*; a smaller cloud on the supernumerary crossvein in cell *Sc*; stigma relatively pale brown, oval; broad but inconspicuous pale brown seams on the cord and outer end of cell *1st* M_2; veins dark brown. Venation: *Sc* relatively short, Sc_1 ending about opposite one-fifth the length of *Rs*, Sc_2 close to its tip; a supernumerary crossvein at near midlength of cell *Sc*; *m–cu* close to the fork of *M*, a trifle shorter than the distal section of Cu_1.

Abdominal tergites dark brown, the sternites obscure yellow; subterminal segments somewhat paler; basistyles more infuscated than the ventral dististyles. Male hypopygium with the tergite transverse, the caudal margin with a shallow U-shaped median notch, the low lateral lobes with about six long conspicuous setæ. Basistyle with the ventro-mesal lobe very large and conspicuous. Ventral dististyle of moderate size, larger than the basistyle, the rostral prolongation boomerang-shaped; the two spines are placed at the extreme base of the prolongation or on the face of the style itself; outer spine from a short basal tubercle, the inner spine from a long fleshy tubercle that is more than one-half the length of the spine, the latter longer and stouter than the outer spine. Dorsal dististyle only gently arcuated, the apex suddenly narrowed into an acute spine. Gonapophyses with the mesal apical lobe long, pale, gently arcuated, separated from the main body of the apophysis by a circular notch.

Habitat.—Paraguay.

Holotype, ♂, Villarica, March 14, 1925 (F. Schade).

Paratopotype, ♂, November 29, 1924 (F. Schade).

The present species is very distinct from all similar regional species in the peculiar structure of the male hypopygium.

Limonia (Geranomyia) immerita, new species.

General coloration of thorax reddish brown, the præscutum with three narrow darker brown stripes, in addition to the broader brown lateral margins; femora obscure yellow, the tips narrowly brighter yellow, without a dark subterminal ring; wings with the pattern very restricted; male hypopygium with the rostral spines straight, arising from small, unequal basal tubercles that are placed at the extreme base of the prolongation.

MALE.—Length (excluding rostrum) about 8.5–8.8 mm.; wing 7.2–7.5 mm.; rostrum about 4–4.2 mm.

Rostrum elongate, as shown by the measurements, black, including the palpi. Antennal scape black, the flagellum obscure brownish yellow to pale brown; flagellar segments oval to subcylindrical. Head gray, with a dusky triangle on either side of the midline of the vertex.

Mesonotal præscutum reddish brown, with three narrow darker brown stripes, in addition to the broader brown lateral margins; a sublateral pale yellow line from the propleura, across the humeri, extending to the suture but becoming more tinged with brown; scutal lobes pale, lined mesally with darker brown; median region of scutum pale, the color extended onto the scutellum; remainder of scutellum plumbeous; postnotum plumbeous, sparsely pruinose. Pleura obscure yellow, vaguely lined longitudinally with darker. Halteres yellow, the knobs infuscated. Legs with the coxæ and trochanters paler yellow, without a dark subterminal ring; tibiæ and tarsi obscure yellow, the terminal tarsal segments infuscated. Wings with a pale yellow tinge, the dark pattern very restricted; stigma oval, pale brown, the

outer portion darker; very restricted dark seams at the supernumerary crossvein in cell *Sc*, origin of *Rs*, Sc_2, along the cord and outer end of cell *1st* M_2; veins yellow, darker in the infuscated areas. Venation: Sc_1 ending about opposite two-thirds the length of *Rs*, Sc_2 close to its tip; a supernumerary crossvein in cell *Sc*; *Rs* long, weakly angulated at origin; *r–m* reduced by approximation of adjoining veins; cell *1st* M_2 long, equal to vein M_{1+2} beyond it; *m–cu* close to the fork of *M*.

Abdomen relatively long and slender; tergites dark medially, paler laterally and less evidently on the caudal portions; sternites obscure yellow. Male hypopygium with the tergite transverse, the caudal margin gently convex, only vaguely emarginate medially. Ventral dististyle large and fleshy, the rostral prolongation slender and relatively small, exceeded by both spines; spines straight, placed at extreme base of the prolongation, the outermost from a scarcely evident basal tubercle, the slightly longer inner spine arising from a slightly larger tubercle and directed basad, the spines thus divergent. Gonapophyses with the mesal apical lobe pale, unusually long and slender, gently curved to the acute point.

Habitat.—Paraguay.

Holotype, ♂, Villarica, October 14, 1924 (F. Schade).

Paratopotypes, ♂, October 6, 1924; ♂, October 28, 1924; ♂, November 17, 1924 (F. Schade).

Limonia (*Geranomyia*) *immerita* is generally similar to *L.* (*G.*) *serotina* (Alexander) and allied forms, differing most evidently in the leg-pattern and structure of the male hypopygium.

Genus *Epiphragma* Osten Sacken

Epiphragma cubensis, new species.

General coloration brown and black; legs yellow, the femora with two narrow dark brown rings, the outermost subterminal in position; tibiæ yellow, the tips narrowly dark brown; wings relatively narrow, hyaline, with a broken brown pattern, arranged about as in *E. buscki;* abdominal tergites bicolorous, the basal portion dark brown, the caudal ring yellowish gray; sternites dark brown.

MALE.—Length about 8.5 mm.; wing 9.5 mm.

Rostrum brown; palpi black. Antennæ (♂) of moderate length, if bent backward ending some distance before the wing-root; scape black; first flagellar segment light yellow; segments two and three paler yellow, the outer flagellar segments black. Head brownish gray, variegated with black, including three confluent areas on the posterior vertex.

Anterior half of mesonotal præscutum much darker than the posterior portion, begin traversed by a Λ-shaped blackish mark, the humeral region restrictedly brightened; posterior portion of præscutum behind the Λ, more olive-yellow, with six brown lines that represent the four præscutal stripes

and two additional dark oval spots in the interspaces; posterior mesonotum pale, the base of the scutellum and the posterior portion of the postnotum blackened. Pleura chiefly velvety-black on dorsal portion, more silvery pruinose on ventral sclerites, the latter forming a broad ventral longitudinal stripe; ventral sternopleurite brownish black. Halteres dusky, the base of the stem and apex of knob more yellowish. Legs obscure yellow, the coxæ more or less pruinose; trochanters yellow; femora yellow with two rather narrow dark brown rings, one at near two-thirds the length, the second a little broader, subterminal, the yellow ring enclosed subequal in area; apex of femur narrowly yellow; tibiæ obscure brownish yellow, narrowly yellowish at base, followed by a dusky clouding, the tips narrowly but conspicuously dark brown; tarsi yellow. Wings relatively narrow, much as in *buscki*, subhyaline, with a brown ocellate pattern that is arranged much as in the last-named species but more interrupted in cells *R* and *M*. Venation: Cell *1st* M_2 less elongate than in *buscki; m–cu* long and weakly sinuous, oblique in position; vein *2nd A* elongate, the cell relatively narrow.

Abdominal tergites bicolorous, the base of each segment dark brown, the more extensive caudal portion yellowish gray; sternites dark brown; hypopygium chiefly pale brown.

Habitat.—Cuba.

Holotype, ♂, Los Llanos, Maisi, Oriente, February 5, 1929 (J. Acuña).

Epiphragma cubensis is allied to *E. buscki* Alexander (Santo Domingo), differing especially in the pattern of the legs and abdomen.

Genus *Polymera* Wiedemann

Polymera (Polymera) microstictula, new species.

General coloration brownish black; mesonotal præscutum with four reddish brown stripes; all tarsal segments whitened, the posterior tarsi most extensively so; posterior tibiæ with a broad white ring at midlength; wings heavily spotted and dotted with brown in all the cells.

MALE.—Length about 6.5 mm.; wing 6.8 mm.

Rostrum and palpi pale yellow. Antennæ (♂) moderately elongate, approximately one-third longer than the body; scape yellow; first flagellar segment obscure brownish yellow; remaining flagellar segments black, the proximal end of each segment narrowly, the apical end more broadly pale yellow, the outermost segments uniformly blackened; basal flagellar segments conspicuously bi-nodose, the outer segments more elongate, nearly cylindrical. Head brownish gray, clearer brown laterally; vertex with three blackish spots.

Pronotum buffy. Mesonotal præscutum with four reddish brown stripes that are narrowly margined with black; scutum with the broad median region and each lobe marked with black, the mesal edge of each lobe narrowly

reddish brown; scutellum black, sparsely pruinose; postnotal mediotergite grayish yellow, the median and lateral portions lined longitudinally with black. Pleura black, the dorso-pleural region paler; pleurotergite yellowish brown. Halteres pale yellow, the knobs dark brown. Legs with the coxæ pale yellow, the extreme bases of the fore coxæ a little darkened; trochanters yellow; femora obscure yellow, brighter basally, with a very broad black subterminal ring, the tips narrowly whitened; tibiæ brownish black, the base narrowly whitened, the amount subequal to the pale femoral apex; remainder of tibiæ chiefly black, a little paler on distal half, the tips narrowly blackened; posterior tibiæ with a broad white ring at near midlength, the setæ and integument both snowy-white; all tarsi extensively whitened, most so on the posterior legs where only the proximal three-fourths of the basitarsi are darkened. Wings yellowish, heavily spotted and dotted with brown in all the cells, least heavy in cell *Sc*; areas at origin of *Rs* and along cord larger; spots beyond the cord tending to form transverse lines across the cells; veins dark brown, *Sc* more yellowish; macrotrichia long and conspicuous. Venation: Sc_1 ending just beyond the fork of R_{2+3+4}; R_{1+2} subequal to $Sc_2 + R_1$ or R_{2+3}; cell M_1 deep.

Abdominal tergites brown, more blackened laterally, the caudal margins narrowly whitened; sternites dusky brown, the caudal margins of the segments very restrictedly pale; hypopygium black.

Habitat.—Paraguay.

Holotype, ♂, Villarica, September 10, 1928 (F. Schade).

Polymera microstictula is one of the most distinct species so far described, the white tibial ring and spotted wings being quite unique among the discovered species.

Polymera (Polymera) superba discalis, new subspecies.

MALE.—Length about 7–7.2 mm.; wing 6.5–6.8 mm.; antenna about 10 mm.

Distinguished from typical *superba* Alexander chiefly by the larger size and more conspicuous yellow discal areas on the wing.

Humeral region of præscutum conspicuously light yellow, on lateral margin behind the suture with a large polished black spot. Black subterminal femoral ring subequal to the subterminal yellow ring. Wings with the discal areas pale yellow, including most of the surface excepting the margin and a brown seam along the cord, more or less distinctly connected with a cloud at origin of *Rs*.

Habitat.—Paraguay.

Holotype, ♂, Caroveni, September, 1928 (F. Schade).

Paratopotype, ♂; *paratype*, a broken ♀, Trinidad, Asuncion, September 2, 1920 (P. Jörgensen).

Genus *Teucholabis* Osten Sacken

Teucholabis (Teucholabis) parishiana, new species.

General coloration obscure yellow, heavily patterned with black, the surface in part pollinose; median præscutal stripe shiny; pleura with a broad silvery stripe; head black, sparsely pruinose; wings subhyaline, the stigma brown; male hypopygium with the outer dististyle a long straight pale rod that is provided with long coarse setæ.

MALE.—Length about 4 mm.; wing 4 mm.

Rostrum black, about as long as the remainder of head; palpi black. Antennæ black throughout. Head black, sparsely pruinose.

Pronotum obscure yellow. Mesonotal præscutum with the ground-color obscure yellow, the disk chiefly covered by brownish black stripes, the broad median stripe shiny, the lateral stripes and interspaces more pollinose; the pale ground-color is barely indicated medially before the suture and at extreme posterior ends of the interspaces; scutal lobes chiefly blackened, the posterior lateral portion more yellowish; median area and scutellum testaceous yellow; postnotum brownish black. Pleura brownish black, with a broad conspicuous silvery longitudinal stripe on the sternopleurite and across the meron; dorso-pleural region restrictedly pale. Halteres pale, the knobs destroyed by Corrodentia. Legs with the coxæ dark; trochanters obscure yellow basally, the tips darkened; remainder of legs chiefly dark brown, the tarsal segments still darker. Wings subhyaline, the small short-oval stigma brown; veins still darker brown. Venation: Sc_1 ending about opposite midlength of *Rs*, Sc_2 at near midlength of distance between origin of *Rs* and tip of Sc_1; R_2 lying just distad of *r–m;* cell R_3 at margin very wide; *m–cu* just beyond fork of *M* and shortly before the other elements of the cord.

Abdomen, including the hypopygium, dark brown. Male hypopygium with the prolongation of the basistyle pale, expanded on basal three-fifths, thence abruptly narrowed into a long blackened spine. Outer dististyle a long pale straight rod that is provided with very long coarse setæ. Inner dististyle short, highly compressed.

Habitat.—Peru.

Holotype, ♂, Iquitos, May 11, 1920 (H. S. Parish).

I take great pleasure in naming this crane-fly in honor of the collector, my old friend and colleague, Mr. Herbert S. Parish. By my key to the American species of the subgenus *Teucholabis* (Trans. Amer. Ent. Soc., 40: 235–239; 1914), the present species runs to couplet 22, disagreeing with both included species.

Genus *Erioptera* Meigen

Erioptera (Mesocyphona) withycombei, new species.

MALE.—Length about 2 mm.; wing 2.8 mm.

Most closely allied to *E.* (*M.*) *modica* Alexander (Mexico) in the unmarked wings and uniformly darkened legs, differing most evidently in the structure of the male hypopygium.

Antennal scape brownish black, the flagellum paler, the segments with long verticils. Head brownish gray. Mesonotum grayish brown; tuberculate pits black; scutellum conspicuously pale. Pleura chiefly light brown, indistinctly striped longitudinally with whitish on ventral sclerites. Halteres uniformly pale yellow. Legs uniformly darkened (only a single detached posterior leg remains). Wings immaculate, subhyaline, the veins and macrotrichia darker. Venation much as in *modica;* vein *2nd A* very gently sinuous. Abdomen dark brown including the hypopygium. Outer dististyle slender and nearly straight, not twisted as in *modica,* gradually narrowed to a slender apical spine; outer margin on distal two-thirds with appressed denticles. Inner dististyle subequal in length, bifid, the main arm expanded into a foot-shaped apical portion, at apex with a comb of slender teeth; mesal arm unusually long, originating on the basal half of the style. Gonapophyses more constricted at base, more slender, especially the long apices. In *modica,* the inner dististyle is more shallowly bifid, the fork originating at or beyond two-thirds the length of the style; the main arm is margined with short blunt teeth.

Habitat.—Trinidad.

Holotype, ♂, St. Augustine, December 29, 1923 (C. L. Withycombe). Type in the British Museum of Natural History, No. 1924–535.

This interesting *Mesocyphona* is named in honor of the collector, whose early death was one of the great losses to Entomology.

THE BLOSSOM WORM, A CRANBERRY PEST[1]

BY C. S. BECKWITH

The blossom worm[2] is a serious pest on cranberry bogs in New Jersey. It works at night so that it has escaped unnoticed many times and possibly the injury it caused was charged to another agent. Dr. J. B. Smith did not mention it in his work ''Insects Injurious in Cranberry Culture'' printed in 1903. In his ''Report of the State Museum, New Jersey Insects'' published in 1909 he listed the insect and says that it should be found in New Jersey but evidently he never considered it as a cranberry pest. The species was described by Grote in 1874 from a specimen collected evidently in the adult stage as no food plants are given. The habitat given includes Massachusetts, New York, Illinois and the middle and central states. H. B. Scammell in his ''Cranberry Insect Problems and Suggestions for Solving Them'' published in 1917 gives a good account of the insect and its occurrence on cranberry bogs.

Mr. A. J. Rider, Secretary of the American Cranberry Growers Association, in his report to the association in 1896 described an infestation of insects which is typical of the blossom worm. He did not have the insect identified but in recent years he has told the writer that it was the blossom worm. Undoubtedly, the insect has occurred for years in New Jersey but the attacks have been so sporadic that the injury and the insect have not been connected sufficiently to allow general recognition of the pest.

The blossom worm is of economic importance more because of the severity of its attacks in isolated cases than because it is present on all bogs every year. Its work is done suddenly and complete destruction of the crop may follow an infestation. Bogs under observation have apparently lost all of their bloom in one night, although the insects had probably been working unnoticed for several nights, and the cutting off of the bloom on the last

[1] Paper of the Journal Series, New Jersey Agricultural Experiment Stations, Department of Entomology.

[2] *Epiglœa apiata* Grt.

night was so obvious that it seemed to have gone all at once. After as severe an infestation as this, a control measure is usually applied and the insect does not appear again for several years.

The blossom worm is listed as a minor pest of cranberries in Massachusetts and is not reported at all from the other cranberry growing regions. The adult moth has been collected throughout the middle and central states but it is not of economic importance on other crops and nothing is known of its feeding habits outside of cranberry bogs.

INJURY

The young worms eat the small young cranberry leaves. At first they eat on one side only, causing the leaf to turn brown. Later they eat chunks out of the leaves usually commencing from the outside edge. They also eat into the terminal buds, consuming the tender interior and causing great loss in fruiting capacity. The large worms are more voracious and often consume entire leaves and at times cut off leaves where they join the main stem. When the new stem is about two inches long, they often attack the lower end, feeding on one side causing the tip to fall over and sometimes actually cutting it off entirely. The occurrence of cut-off and partly cut-off stems in early June indicates the presence of the worms and will be spoken of again under control.

The economic injury from which it gets its name is the cutting off of the blossoms at a point just below where it joins the stem. This, of course, eliminates the possibility of fruit production on the stems where it occurs. Some idea of the extent of the possible injury may be had from the work of ten worms confined to cages and fed fresh blossoms every day. During the season, the worms cut off and consumed an average of seventy-one blossoms per worm and, in addition, cut off but did not consume twenty-one and partly cut off eight more. This work was spread over three weeks. In this case, each worm destroyed about 100 blossoms, enough to make a fair crop on a square foot. In several instances as many as ten worms have been found on a square foot.

After the fruit sets, the worms sometimes eat the small berries although this injury is not usually serious because the worms are normally through eating before much fruit is set.

SEASONAL HISTORY

The insect overwinters as an egg. The eggs hatch rather irregularly in late May and June on bogs where the winter flow was removed May 10. One lot of eggs was held under water until May 10 and then poured out to dry. Three hatched that night. No more hatched until May 24. From then on the record was as follows:

May 24	6	Hatched	June 4	5	Hatched
25	5	"	5	6	"
27	3	"	6	8	"
29	3	"	9	7	"
31	3	"	10	5	"
June 1	5	"	12	9	"
2	7	"	15	4	"
3	12	"	17	1	"

Eggs that had not been held under water at all during the winter hatched between April 27 and June 6, mostly during May. Observations on bogs on which the water was held until May 20 in 1929 showed blossom worms still hatching the last week in June.

This extended period over which blossom worm eggs hatch is rather unusual for cranberry insects. The presence of worms of various sizes on the bog on June 10 has been noted but it was thought that this was due to eggs being deposited at different levels on the bog, thus allowing some to be exposed earlier than others. However, in this experiment, all eggs were held at one level and taken out at one time.

THE LARVÆ

The newly hatched caterpillar is yellowish green in color and about one-seventh of an inch long. It feeds on the buds and leaves but does not consume very much food during the early stages. In the later instars when the worm is about five-eighths of an inch long, the color changes to chocolate brown with a longitudinal light stripe along each side and a dark stripe in the middle of the back. The head is somewhat lighter in color, although it is also dark brown.

The full grown worm is slightly over one and one-fourth inches long.

On a bog from which the winter flow was removed May 10 worms were collected on June 8. Seventy-two were measured and it was found that one was 0.4 of an inch long, nineteen were 0.5 of an inch long, thirty-two were 0.6 of an inch long, fifteen were 0.7 of an inch long, four were 0.8 of an inch long and one was 0.9 of an inch long.

Some of the same catch was placed in cages, one cage to a worm, and fed all that they would eat. They became full grown and cocooned as given in the following table:

COCOONING DATE OF THE BLOSSOM WORM

Date	No. cocooned	Date	No. cocooned
June 28	1	July 9	5
29	1	10	5
30	2	11	4
July 1	3	12	5
2	4	13	5
3	3	14	2
4	5	15	2
5	13	16	2
6	8	17	3
7	7	18	1
8	6		

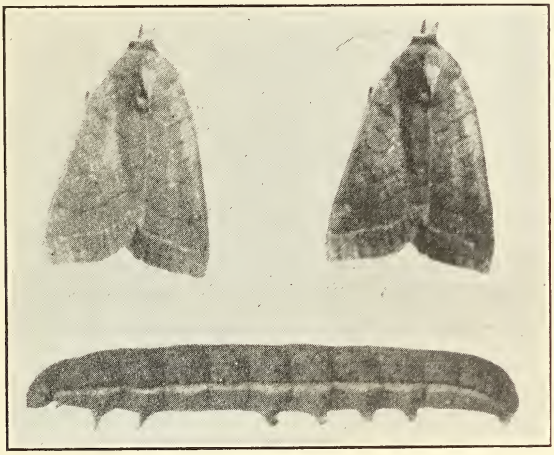
COCOON

The cocoon is a loosely woven web of silk and debris that is formed in the trash on the bog floor. If the trash is not thick they sometimes enter the sand a short distance. They pupate within the same cell before September 1.

ADULT

The adult moths begin to appear early in September, emerge in considerable numbers the last week in September, and are found in greatest numbers during the first week in October. They may be found on badly infested bogs all through October and occasionally in November. They do not fly much during the

day and are often discovered accidently by being stirred out of the vines by the harvesting operations. Ordinarily, a flight of about ten feet to get out of the way of the scoopers is all that occurs, although flights of 200 feet have been observed. On alighting they crawl among the vines quickly so that they are not easily found.



Moths of the blossom worm (slightly enlarged). Full grown larva of *Epiglœa apiata* Grt. (enlarged one third).

At night they are attracted to light to some extent, although not enough to make light trapping successful.

Eggs are laid over a period of two weeks. They are placed singly on dead leaves or small twigs on the bog floor. The female moths confined in cages laid between 100 and 200 eggs apiece.

CONTROL

The first measure of control is to locate the presence of an infestation. The insect does not occur with any degree of regularity so that it would be folly to treat a bog without first determining whether or not it is present.

The worms should be located during the first fifteen days of June if control measures are to be effective. During this period, all unusual activity of birds working among the vines should be

investigated carefully. Localized infestations have often been located in this manner. The cut-off tips of vines, with some hanging so that the undersides of the leaves show, is also a good indication of the presence of this or a similar insect and should be investigated. Other typical feeding marks of the pest will help to locate it.

Finding the worm itself is rather difficult. It rests during the day on a stem and the blending of its color with that of the stem prevents its detection. If disturbed it usually drops to the ground where it may curl up and remain motionless for some time. A grower must be patient to succeed in this search. Doctor Franklin suggests sweeping the vines with an insect net and the writer has taken some worms in this manner. The net is best used in the evening as the worms are starting to feed at that time and are more likely to be near the tops of the vines.

After locating the blossom worm, the control is relatively simple. Two very efficient methods are available for use and the choice may be made to suit the conditions.

Flooding is the simplest method if it can be applied. A twenty-four hour reflow between June 5 and June 10 is ample to kill the worms on a bog. They float to shore or are picked up off the water by the numerous birds that are attracted to the flooded bog. They are usually unable to crawl up out of the water if they have been in it for an hour or more so that many die in the wash at the shore. The treatment has been effective every time it has been under observation in New Jersey. Of course, water for reflooding is not always available and often it cannot be handled quick enough to get the water off before some injury is done to the vines. It is a treatment that must be used with considerable care. It cannot be used safely if the infestation has not been discovered until after the 10th of June, as the bloom is too far advanced to survive prolonged submerging.

The alternate control method is spraying with lead arsenate or other poison. This has been used many times with success in New Jersey and no failures have come under our observation. The lead arsenate should be used without soap, especially resin fish oil soap. Soap spray applied either before or after the

arsenate of lead will cause burning when the two materials come together on the vines.

NATURAL CONTROL

The blossom worm is attacked by numerous birds, the most common of which is the red-winged blackbird. These blackbirds not only destroy a great many worms, but by their activity on the bog indicate the presence of an infestation to the grower.

INSECT PARASITES

Sagaritis oxylus Cresson is a common parasite of the blossom worm. Out of seventy-two worms collected on June 8, twenty-five were parasitized with this insect. All infested worms died before the fifteenth of June and the parasite pupated within the body walls of the dead worm. On June 21 some flies emerged and these were given an opportunity to attack the larger blossom worms. The worms died in a few days but no new brood of flies matured, possibly due to the lack of food for the number of parasites that had to grow in the few worms available. However, even without the second brood, *Sagaritis oxylus* Cresson may be considered a very effective parasite.

This parasite also attacks *Leucania unipuncta,* the army worm, and *Laphygma frugiperda* S. and A., the fall army worm. Our specimens were determined by R. A. Cushman of the Bureau of Entomology.

Euplectrus bicolor (Swed.). This parasite is very small and lives in a group of twenty or more on the outside of the blossom worm. In every collection of worms, a few have been found infested with it. The group, first as a mass of eggs and later as a mass of larvæ, hang on the back near the head of the host. The host dies about the end of June and the adults emerge. This is not a very important parasite but it seems to be present regularly. It was identified by S. A. Rohwer of the United States National Museum.

Rogas sp. (very similar to *Rogas aciculatus* Cress.) is a parasite very common in the worms collected in early June. This parasite kills the host about June 25 and it then crawls outside of the body of the host and goes through its pupal stage in the

dried up skin of the last larval stage. It hangs about a half inch below the leaf or stem on a fine thread. The adult emerges the last of June or early in July. We have no record of this pest entering other hosts but probably it infests other large worms that are common during the summer.

Tachinidæ. A tachinid parasite is quite common on full grown blossom worms. The insect has not been reared because all of the specimens collected were also parasitized with other forms that killed the host before the tachinid was able to complete its life cycle. The eggs of this species are laid just back of the head on the large blossom worm during the latter part of June. Occasionally, two or more eggs are placed on a single worm and in such cases, some of the eggs might be placed on the abdomen. The eggs hatch in a few days and the maggot enters the worm. No emergence records were made.

Conclusions

The blossom worm has long been a cranberry pest in New Jersey.

Its chief injury is the cutting off of the flowers, often the entire crop being ruined in this way.

It is easily controlled by flooding or spraying if the infestation is promptly located.

Insect parasites are very numerous and they keep the pest from multiplying greatly under ordinary conditions.

ON THE SYSTEMATIC POSITION OF THE SPIDER GENUS NICODAMUS SIMON

BY ALEXANDER PETRUNKEVITCH, PH.D., D.SC.
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In every animal group there are some genera which exhibit characters normally distributed over two or more families. Such genera are stumbling blocks to taxonomers and are considered to be transitional by zoologists who see in them the strongest support for the theory of evolution. Under the influence of genetics and experimental zoology we have considerably departed from this orthodox point of view and realize now that structurally transitional characters may not mean close genetic relationship. The apparent similarity is explained on the basis of converging evolution or functional adaptation, as I prefer to term it. The transitional character of the genus becomes illusory and if the true nature of the animal is established it ceases to be placed under the one or the other family in agreement with the point of view of the systematist and is definitely given its place in the system.

Such is the case of the spider genus Nicodamus. The genus was established by L. Koch in 1872 for a Tasmanian spider and given the name Centropelma, with *C. bicolor* as type species. The generic name being preoccupied, the great French arachnologist Simon changed it in 1887 to Nicodamus, leaving it at that time in the family Theridiidæ as has been done by Koch and by his successor Count Keyserling. Since its conception and until 1898 it remained in that family. But in 1898 Simon published the second fascicle of his monumental *Histoire Naturelle des Araignées* in which he referred the genus "with some doubt" to the family Agelenidæ, adding that its "very ambiguous characters are not sufficiently outstanding (pas assez tranchés) to be used as a basis for a special family" (Translation mine—A. P.). The reason why Simon placed the genus Nicodamus among the Agelenidæ is that the five or six species belonging to it exhibit

affinity especially with Cybæus in the structure of their spinnerets and sexual organs, characters which Simon considers more important than cheliceræ and mouthparts. The analysis and description which Simon gives are very good, but contain a few slips and omissions, particularly concerning the investiture and trichobothria. Nevertheless Simon's authority was so great that Rainbow retained his classification in the Census of Australian Araneidæ, published in 1911, and I myself did the same in my paper "On Families of Spiders," in 1923, although Dahl reunited them with the Theridiidæ on the basis of the difference between them and the Agelenidæ, furnished by the distribution of the trichobothria. This character is often valuable, and I, too, have used it to some extent, but I doubt that it has such fundamental value as Dahl ascribes to it. Moreover, in the case of Nicodamus the only specimen which I had seen was not sufficiently well preserved to permit the study of trichobothria. Through the courtesy of Mr. V. V. Hickman who has sent to me a few Tasmanian spiders I was now placed in the position of subjecting to a careful study a male and a female of *Nicodamus bicolor* from Launceston, Tasmania, both specimens in excellent condition. Students of arachnology will be interested to know the result of this study.

The general appearance of both sexes, apart from their vivid color, is that of a Theridiid spider, such as a Dipoena, but with more oval abdomen. The shape of the carapace reminds more of that of Latrodectus among the Theridiidæ, than of any Agelenid that I am acquainted with. Of the eyes only the anterior median ones are diurnal, the others, though round and transparent, exhibiting a silvery white retina in artificial light. The cheliceræ are distinctly those of a Theridiid. They are without boss (condyle), are stout and parallel. Their margins are short and transverse. There is a single tooth at the juncture of the two margins, but the margins themselves are smooth and there is no scopula on either of them, but only a few stiff hairs. A stridulating ridge is wanting. The fang is short, stout and evenly curved. The maxillæ are also of the Theridiid type. They are inclined toward each other over the lip and each maxilla has parallel sides. At the end the maxillæ are so trun-

cated that their serrulæ lie in the same plane. The lip is wide at base, trapeze-shaped with straight suture. The sternum is flat, triangular, with slightly convex sides. It is almost, though not quite as wide as long, with the base of the triangle in front and the blunt apex between the hind coxæ which are separated by somewhat less than their width. The first coxæ are wide apart. In this the sternum reminds again of some Theridiids, rather than of Agelenids. The abdomen is ovoid, clothed with long, stout, black bristles. There is no stridulating organ in either sex on the abdomen. The spinnerets differ both from the typical Theridiidæ and the Agelenidæ even of the Cybæus group. With colulus and anal tubercle they form a circle, but the colulus is low and wide and bears some ten hairs which make it more apparent than it would be without them, while the anal tubercle is large and cone-shaped. The anterior pair of spinnerets is by far the stoutest. They are cone-shaped and contiguous at their base. Although Simon states that these spinnerets are composed of a single segment, he is mistaken on this point. The anterior spinnerets show distinctly a second segment separated from the first segment by a white connecting membrane. This second or terminal segment is very short and bears on the entire, slightly curved surface of its end simple spinning tubes. The pair of posterior spinnerets are wide apart at base. They are much thinner and a little, but not much longer than the anterior pair. Their second segment is longer than the first, is cone-shaped and has simple spinning tubes on its inner surface toward the end. The median pair of spinnerets is very short and stout. They are situated behind the anterior pair and are in contact with that pair and with each other. On their truncated surface they have large spinning spigots. The legs are short and stout in both sexes. Spines are present, but their distribution is irregular, or at least not as in Agelenids. The distribution of trichobothria, on the other hand, is much as in Theridiids. There are two rows of them on all tibiæ, three in one row and four in the other. There is also a single trichobothrium on all but the fourth metatarsus toward the end. In the female there are also two rows of two and three trichobothria on the tibia of the palp and in the male a single trichobothrium on the apophy-

sis of the tibia of the palp. No trichobothria elsewhere. Onychium and spurious claws wanting. Upper claws with a series of teeth, comparable to, but more numerous than in Latrodectus. Third claw smooth. Serrated bristles are present in both sexes on the fourth tarsi and even at the end of the fourth metatarsi, but the tarsal bristles do not form a distinct "comb." However, under high power the bristles exhibit their structure clearly and show a series of sharp spines all along their ventral edge. Nicodamus is herein similar to other aberrant Theridiids, but not to Agelenids. The structure of the epigynum and male palp could be of use in comparison with other spiders only if studied after clearing with potassium hydrate and oil. Too much stress has been of late laid on the structure of external organs of reproduction. They are subject to variation as much as and in some cases more than other organs. In the individual life of a spider they are the last organs to appear. Owing to the work of various investigators we know the structure and surmise the function of the various parts of the epigynum in many spiders. Of the palp we know practically nothing. The principle on which it is built is the same in all spiders. The complication of accessory structures is tremendous and their function beyond the wildest guess. Tibial apophyses have developed in various families and are not quite unknown among Theridiidæ. The spiral form of embolus is just as typical of Latrodectus and some other Theridiidæ as of some Agelenidæ. The habit of Nicodamus of living under rocks is in common with some Theridiidæ.

Considering the distinctive characters of Nicodamus and comparing them with representatives of Theridiidæ and Agelenidæ we cannot escape the conclusion that Nicodamus has practically nothing in common with the latter and a great deal in common with the former. To my mind there can be no doubt that Nicodamus is a Theridiid and allied to the Latrodectinæ from which it may be separated by the structure of its posterior spinnerets and the poor differentiation of a tarsal comb.

THE ENTOMOLOGY OF THE "MENAGIER DE PARIS"

When the Ménagier de Paris wrote his treatise on moral and domestic economy about 1393, for the guidance of his very young bride so that she would be a perfect wife and proficient in household affairs, both desirable when she married again, he included therein what was considered, at the time, to be the best information on the control of household insects.

"*Le Ménagier de Paris,* traité de morale et d'économie domestique, composé vers 1393, par un bourgeois parisien," was recently translated for the first time into English by Eileen Power,[1] and although the limited French edition of 1846 has long been known to students of social history the economic entomology of the work is not so well known to entomologists, and the extracts reproduced here will give one a glimpse of the methods used by the citizens of Paris during the middle ages in their conflicts with fleas, flies, mosquitoes and the like.

Thus on the subject of fleas, the Ménagier said, "And in summer take heed that there be no fleas in your chamber, nor in your bed, the which you may do in six ways, as I have heard tell. For I have heard from several that if the room be strewn with alder leaves, the fleas will be caught thereon. Item, I have heard tell that if you have at night one or two trenchers [of bread] slimed with glue or turpentine and set about the room, with a lighted candle in the midst of each trencher, they will come and be stuck thereon. The other way that I have tried and 'tis true: take a rough cloth and spread it about your room and over your bed, and all the fleas that shall hop thereon will be caught, so that you may carry them away with the cloth wheresoe'er you will. Item, sheepskins. Item, I have seen blanchets [of white wool] set on the straw and on the bed, and when the black fleas hopped thereon, they were the sooner found upon the white, and killed. But the best way is to guard oneself against those that be within the coverlets and the furs, and the stuff of the dresses wherewith

[1] The Goodman of Paris, New York, 1928.

one is covered. For know that I have tried this, and when the coverlets, furs or dresses, wherein there be fleas, be folded and shut tightly up, as in a chest tightly corded with straps, or in a bag well tied up and pressed, or otherwise put and pressed so that the aforesaid fleas be without light and air and kept imprisoned, then they will perish forthwith and die.''

On the subject of mosquitoes he was not very loquacious and mentioned only the use of smoke from burning straw and the protection afforded by mosquito netting. But on the subject of flies, he unburdened himself of many suggestions and wrote:

''And if you have a chamber or a passage where there is great resort of flies, take little sprigs of fern and tie them to threads like to tassels, and hang them up and all the flies will settle on them at eventide; then take down the tassels and throw them out. Item, shut up your chamber closely in the evening, but let there be a little opening in the wall towards the east, and as soon as the dawn breaketh, all the flies will go forth through this opening, and then let it be stopped up. Item, take a bowl of milk and a hare's gall and mix them one with another and then set two or three bowls thereof in places where the flies gather and all that taste thereof will die. Item, otherwise, have a linen rag tied at the bottom of a pot with an opening in the neck, and set that pot in the place where the flies gather and smear it within with honey, or apples, or pears; when it is full of flies, set a trencher over the mouth and then shake it. Item, otherwise, take raw red onions and bray them and pour the juice into a bowl and set it where the flies gather and all that taste thereof will die. Item, have whisks wherewith to slay them by hand. Item, have little twigs covered with glue on a basin of water. Item, have your windows shut full tight with oiled or other cloth, or with parchment or something else, so tightly that no fly may enter, and let the flies that be within be slain with the whisk or otherwise as above, and no others will come in. Item, have a string hanging soaked in honey, and the flies will come in and settle thereon and at eventide let them be taken in a bag. Finally meseemeth that flies will not stop in a room wherein there be no standing tables, forms, dressers or other things whereon they can settle and rest, for if they have naught but straight walls whereon to settle and cling,

they will not settle, nor will they in a shady or damp place. Wherefore meseemeth that if the room be well watered and well closed and shut up, and if nought be left lying on the floor, no fly will settle there.''

For the clothes moth airing and brushing were recommended. ''Because such vermin gather when the cold weather of autumn and winter groweth milder and be born in the summer, at such time it behoves you to set out furs and stuffs in the sun in fair and dry weather; and if there comes a dark and damp mist and clingeth to your dresses and you fold them in such condition, that mist folded and wrapped up in your dresses will shelter and breed worse vermin than before. Wherefore choose a fine dry day and as soon as you see heavier weather coming, before that it reacheth you cause your dresses to be hung up under cover and shaken to rid of most of the dust, then cleaned by beating them with dry rods.''

His instructions on the art of gardening included a remedy for ants and cabbage caterpillars. ''Note, that ants abound in a garden and if you cast sawdust of oaken planks upon their heap, they will die or depart at the first rain that falleth, for the sawdust retaineth the moisture. . . . Note, that if the caterpillars eat your cabbages, do you spread cinders beneath the cabbages when it rains and the caterpillars will die. Item, you may look under the leaves of the cabbages and there you shall find a great host of white grubs and know that it is from these that the caterpillars be born, wherefore you should cut off the leaves whereon is this seed and cast them afar off.''

Thus ends the entomological advice which the Ménagier de Paris gave to his wife along with lengthy instructions on religious and moral duties, womanly behavior, social duties, the subject of dress, household management, gardening, the making of sausages and candied orange peel, etc., etc., etc., all designed to transform her into a paragon of uncomplaining submissiveness and continued attentiveness—and to preserve and keep Le Ménagier from all discomforts.—HARRY B. WEISS.

LIFE HISTORY NOTES ON SOME LEAFHOPPERS THAT OCCUR ON NEW JERSEY CRANBERRY BOGS[1]

By Charles S. Beckwith and Sidney B. Hutton

In connection with other studies, we have made sweep net collections on cranberry bogs almost daily during the growing season for the last two years. The leafhopper population was recorded both as to species and the stage of its life history at the time of collection. A tabulation of these records has given a fairly definite seasonal history of the more common species and the few points not cleared up in this manner were investigated further in cages. A few observations were recorded about the less common species.

For the readers who are unfamiliar with cranberry culture, it may be well to point out some of the unusual features of bog conditions. The cranberry is a low-growing evergreen vine which covers the ground completely under the best of conditions but often grasses and other weeds occur in spots among the vines. The water table is about twelve inches below the surface, assuring moist conditions, and the bogs are completely submerged from December 15th to about May 1st. Of course, no leafhopper can hibernate on the bogs in anything but the egg stage. The ground adjacent to the plantations is almost invariably native growth of trees or shrubs.

Euscelis striatulus Fallen is by far the most common leafhopper on the bogs during the summer. It winters as an egg laid just under the bark of the new wood. The egg is cylindrical with rounded ends and averages 1 mm. in length and 0.25 mm. in diameter. Hatching occurs from May 24 to June 20. The average length of the nymphal instars are first, four days; second, six days; third, fourth and fifth, seven days each. The female adult averaged 4 mm. in length and males a little shorter.

[1] Paper of the Journal Series, New Jersey Agricultural Experiment Station, Department of Entomology.

First adults appeared on June 30 in 1928 and on June 23 in 1929. Nearly all nymphs reached maturity by the fifteenth of July although a few were found until early August. The number of this species starts to diminish by the first of August but the more noticeable falling off is after August 15. A few individuals may be found throughout September and the first week in October. There is but one brood a year. This species feeds on the cranberry vines exclusively while on the bogs and its preference for girdled or otherwise weakened vines is very noticeable. It has not been found to occur on huckleberry or other shrubs around the bogs but appears to live only on the cranberry vines in this locality.

Platymetopius magdalensis Prov. is one of the more common species found on the bogs. It winters as an egg in the leaf of the cranberry. The eggs hatch the last week in May and the adults appear the last week in June, some surviving until the end of July. Another brood starts to hatch the last week in July and the adults are common the first half of September. A few are found throughout October. Two well defined broods a year are therefore indicated. This species feeds on cranberries principally if not exclusively.

Thamnotettix smithi Van Duzee ranks third in numerical importance on cranberry bogs. The adults have been caught as early as May 24th which indicates that this species overwinters as an adult on the banks of the bogs. Nymphs are found early in June and are common early in July but are gone by August 1. Another brood develops during August and September, the nymphs being found up to September 26 and the first adults found September 16. Adults of this species were found late in October when the last sweeping, for the season were made. This species feeds on grasses, chiefly *Carex bullata* Schkuhrs and when caged with only cranberry vines it died within two days. It is not found in pure stands of cranberry vines but occurs in considerable numbers in the small patches of grass scattered through the bogs.

Gypona octolineata var. *striata* Burmeister is generally distributed over cranberry bogs in limited numbers. Its large size makes it particularly noticeable. In 1927 nymphs were found

from June 29 until August 2, adults from July 28 to September 30. In 1928 a nymph was found on May 19, which would indicate that the nymphs found in July 1927 were of a second brood.

Cicadula sexnotata Fallen is another common species on the cranberry bogs. Adults are found on bogs in May and early June indicating overwintering as adults. Adults are present most if not all of the time during the summer. Nymphs were taken in July and August only. The adults are strong fliers, some individuals being caught in the center of a twenty acre bog two days after the water was drawn off. Its food was not definitely determined but we believe it to be a grass feeder.

Thamnotettix nigrofrons Forbes adults have been taken from July 28 to October 11. Numerous nymphs about half grown were found on August 12. They occur on grass spots in cranberry bogs and not on clean vines. When confined with only cranberry vines for food, they died.

Additional species found occasionally in cranberry bogs are: *Empoasca mali* LeBaron; *Thamnotettix melanogaster* Prov.; *Chlorotettix viridius* VanDuzee; *Platymetopius hyalinus* Osborn; *Parabolocratus viridis* Uhler; and *Agallia constricta* VanD.

Most of the species were identified by Mr. Chris Olsen of the American Museum of Natural History. Dr. Herbert Osborn identified *Platymetopius magdalensis* Prov.

TAXONOMIC STUDIES IN COLEOPTERA, WITH NOTES UPON CERTAIN SPECIES OF BEETLES IN THE CHICAGO AREA, I

By ORLANDO PARK
Whitman Laboratory, University of Chicago

During the course of ecological studies on the Coleoptera of the Chicago area covering the last eighty-five months (Park, 1929, a, b), certain apparently new species and varieties of beetles have been found and this opportunity is taken to describe some of them. I am indebted to my friends, Mr. W. J. Gerhard, Mr. Emil Liljeblad, and Mr. A. B. Wolcott of the Field Museum of Natural History for aid and criticism.

COCCINELLIDÆ

Adalia bipunctata schuetti var. nov.

This is a well-marked variety of the ubiquitous species, *Adalia bipunctata* (Linn.) generally indistinguishable from the latter, save for a minute, usually oboval, black maculation in the median marginal area of each elytron (Fig. 2a), and being separated from the margin by its approximate width, these marginal maculæ being between a twentieth to a fortieth as large as the typical elytral maculæ of the species.

Length 4.8–5 mm.; greatest width 3.2–3.5 mm.

Represented by five specimens in the collection of the author, taken at Chicago, Illinois (on sidewalks, fence posts and trees between 54th and 59th streets and Harper and Kenwood Avenues). The type locality is defined here in such a form since random collecting over other areas of the city did not yield additional type material. These five individuals were all taken in late summer. The type was taken on July 10, 1923, by the author. The four paratypes were collected between August 22 and September 18, 1929, by Mr. J. F. Schuett, in whose honor this variety is named.

These specimens are apparently unique in their maculation, and do not approach the known forms of *Adalia,* including the various experimental hybrids of Miss Palmer (1911, 1917).

Otherwise, the variety is typically *bipunctata* in aspect, in maculation, and in size and coloration.

CRYPTOPHAGIDÆ

GLYPTOPHORUS gen. nov.

This genus is allied to that group of genera of the Cryptophaginæ which have the mesosternum not emarginate and the priminent convex eyes situated at the base of the head. From *Crosimus* and *Salebius*, its nearest relatives, it may be readily distinguished by the following generic characters:

Pronotal margins not triundulate as in *Crosimus* and *Salebius*, but distinctly serrate (Fig. 1, a), as in certain Cucujidæ and Derodontidæ. The serratures being approximately the same size, usually acute, recurved, and bearing a backward directed hair.

Pronotal lateral margins without the sublateral carinæ from base to apex as in *Crosimus;* the carinæ being entirely absent, as in *Salebius.*

Pronotum deeply bifoveate at base and connected by a broad, sloping groove adjacent to the basal margin, the groove being very sparsely to non-punctate.

Scutellum and elytra of similar shape and sculpture as in *Crisomus hirtus* Casey.

Last (distal) segment of maxillary palpi elongate, subacute in the males, more rounded in the female; three times as long as next to the last segment.

Eyes not hairy.

Prosternum and prosternal episternum coarsely punctate, as in *Crosimus;* the punctures becoming much less coarse and almost absent at the pronotal margin in *Glyptophorus* in distinction from *Crosimus* where the punctures of the prosternal episternum are distinct and large up to the pronotal margin. A well-marked, rather deeply excavated, elongate-oval pit anterior to the pro-thoracic coxæ, on the pronotal episternum. This elongate pit lies adjacent to, and follows the curve of the pronotal episternal-prosternal suture, and is not punctured and narrowed at the anterior end. In *Crosimus* this area is punctate and but little depressed.

Glyptophorus mycetœcus sp. nov.

Head, pronotum and ventral surface dark, rufo-testaceous; legs and antennæ lighter rufo-testaceous. Lateral margins, apical third and an obscure postscutellar area of the elytra dark rufo-testaceous; the median third and humeral areas rufous in the allotype and one male paratype, and darker rufous in the holotype.

Head, thorax and abdomen dorsally and ventrally clothed with rather coarse, rather deep punctures, each usually bearing a stout, decumbent yellowish hair. Eyes very convex and rather coarsely faceted, although not as coarsely as those of *Cryptophagus.* Antennæ 11-segmented; the first segment large, subglobular; second as long as first but more slender and oboval; third one and one-half times as long as fourth; fourth shorter than

either third or fifth; sixth to eighth equal in size, subglobular; ninth to eleventh suddenly larger, forming a loose, three-segmented club of approximately the same width; eleventh segment obliquely acute as in *Crosimus*. Pronotum with the lateral margins provided with eight to nine rather large serratures (very much larger than the serrulations of *Henoticus*), these teeth quite generally recurved and regular; no trace of sublateral, pronotal, carinæ; base strongly bifoveate, the foveæ being deep, conspicuous and connected near the basal margin by a wide, very sparsely to non-punctate groove. Abdomen with five free sternites, the first twice as wide as the second; second to fifth of approximately the same width. Female with all tarsi five-segmented; males with the pro- and meso-tarsi five-segmented, the meta-tarsi four-segmented; tarsal segments rather slender, not lobed beneath and bearing beneath rather long hairs; claws simple; last meta-tarsal segment (fourth) as long as first to third in the males; last meta-tarsal segment (fifth) of the female shorter, with fourth as long as third. Scutellum and elytra much as in *Crosimus hirtus* Casey.

Males: 1.8–1.9 mm. long; .8–.85 mm. wide.

Female: 2.0 mm. long; .9 mm. wide.

Described from three specimens, two males and one female, in the collection of the author, taken May 2, 1927, in the decaying tissues of the fungus, *Hydnum septenrionale* on the moist, rich soil of a climax sugar maple forest near Joliet, Illinois (Pilcher Arboretum).

This species forms an interesting addition to the fauna of this area, since the nearest relatives of the genus *Salebius* erected by Casey (1900) are apparently limited to the extreme western states, and the Pacific region. *Glytophorus* is distinct from allied genera on a number of morphological points, as the pronotal characters mentioned, although its members have a deceptive appearance and superficial similarity to *Crosimus*. Casey (*loc. cit.*, p. 90) says of *Salebius*, "This genus, with *Crosimus*, is distinguished from *Cryptophagus* by having three subequal obtusely dentiform nodal points along each side of the prothorax, at the apex and near the apical and basal fourth of the length, instead of a single nodal point, with a submedian spicule as in that genus." The strongly serrate pronotal lateral margins of *Glytophorus* readily separates this genus from others in the subfamily.

The three individuals of *mycetœcus* were taken with a number of related species, *e.g.*, with *Crosimus hirtus* Casey, *Henoticus serratus* (Gyll.), *Cryptophagus acutangulus* Gyll., and *C. nodan-*

gulus Zimm. in an interesting fungus community (Park, 1929b), and all four of these associated species have been recorded for Indiana by Blatchley (1910). For purposes of orientation, the following generic key, in part based on a modification of the one used by Blatchley (*loc. cit.*, pp. 570–571), may be of service:

Cryptophaginæ with the mesosternum not emarginate; the prominent convex eyes situated at the base of the head:

A. Lateral pronotal margins serrate, the serratures recurved and of approximately the same size and intervalation; sublateral carinæ entirely absent; base deeply bifoveate, the foveæ connected by a wide groove along the basal margin........ **GLYPTOPHORUS** gen. nov. (Fig. 1 a).

AA. Lateral pronotal margins not as above

B. Lateral pronotal margins triundulate (at apex, and near the apical and basal thirds)

C. Pronotal disk with a sublateral carina on each side*........ **CROSIMUS** Casey. (Fig. 1 b).

CC. Pronotal disk without sublateral carinæ........ **SALEBIUS CASEY.**

BB. Lateral pronotal margins not triundulate

D. Apical pronotal angles thickened and obliquely truncate; lateral pronotal margins even save for minute serrature often present near the middle of the margin; portions of the lateral margins generally obsoletely, obtusely serrulate........ **CRYPTOPHAGUS** Herbst. (Fig. 1 c).

DD. Apical pronotal angles not thickened or obliquely truncate; lateral margins more or less serrulate

* In the specimens of *Crosimus hirtus* Casey at hand, the sublateral carinæ are joined apically by a fine, distinct groove some distance from the raised apical margin, and the determination of these individuals is a provisional one since they may represent a new species of *Crosimus*. Casey (1900) in his description of the genus *Crosimus* does not mention any such apical groove connecting the sublateral carinæ. To clear up this point as much as possible Mr. L. L. Buchanan, of the Bureau of Entomology, through the courtesy of Dr. T. E. Snyder and Mr. Harold Morrison, kindly examined the type of *hirtus* Casey. His personal communication and enclosed drawing aided materially on this point and a portion of the former follows: "The two sublateral carinæ join the apical margin and are connected by it. There is also what appears to be a very fine groove along the rear edge of the apical margin that connects the two carinæ. I am not certain that this so-called groove is actually such; the apical margin is somewhat thickened and raised above the general pronotal surface and the appearance of the fine groove may be due to certain light reflections."

E. Lateral pronotal margins unevenly but distinctly serrulate; pronotum with distinct basal groove; body oval, convex, coarsely pubescent .... **HENOTICUS** Thomson. (Fig. 1 d).

EE. Lateral pronotal margins very minutely serrulate; pronotum lacking basal groove, base minutely bifoveate; body oblong, parallel, depressed, finely pubescent .... **PTERYNGIUM** Reitter.

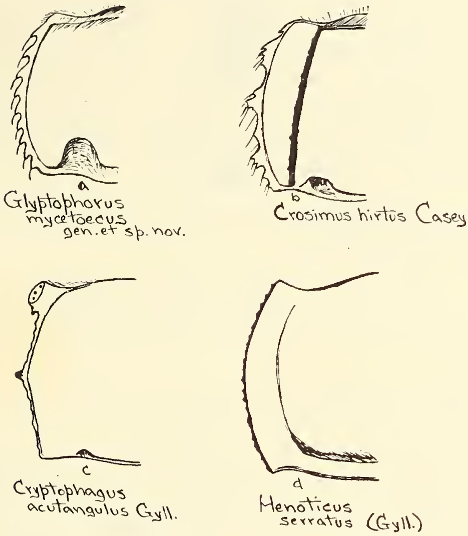

Fig. 1
(Drawn under 90 x)
Pronotal Characters in Certain Cryptophaginae.

CUCUJIDÆ

In working over certain groups in the Cucujidæ, the species of *Læmophlœus* occurring in the Chicago area were reviewed and the following key may be used to supplement the one employed by Blatchley for the Indiana fauna (*loc. cit.*, p. 566) since the genus is a difficult one.

LÆMOPHLŒUS Lap. 1837

A. Second segment of antennæ shorter than third

B. Labrum emarginate; elytra with a pale spot before the middle of each; larger (2.7–4 mm.)

C. Surface densely punctate; elytral spots well-defined and regular in form but variable, however, in a long series; the pronotal disk densely punctate with coarser punctures and dark testaceous; pubescence yellowish and longer than in the next species; lateral pronotal margins with from three to four serratures between the apical and basal angles; space between the basal pronotal groove and basal margin wider and sparsely to non-punctate........ *biguttatus* Say.

CC. Surface finely and sparsely punctate; elytral spot less well-defined and irregular, but variable in a long series; pronotal disk sparsely and more finely punctate, lighter testaceous with golden and shorter pubescence; lateral pronotal margins with one serrature on basal third and often an obsolete serrulation on apical third; space between basal groove and basal margin much narrower........ *fasciatus* Melsheimer.

BB. Labrum entire; elytra not spotted; smaller (1.4–2.1 mm.)

D. Body convex

E. Front angles of pronotum toothed. . *convexulus* Lec.

EE. Front pronotal angles rounded........ *adustus* Lec.

DD. Body depressed; elytra shorter than abdomen........ *modestus* Say.

AA. Second antennal segment equally as long as third; pale rufotestaceous; elytra not spotted (1.5–2.1 mm.)

F. Fine, transverse groove on head behind the eyes paralleling apical pronotal margin, and usually covered by the latter, present; thorax and elytra lightly pubescent; pronotum with sparse, finer punctures than the following species........ *testaceous* (Fab.) (*liquidus* Casey?)

FF. No trace of such a transverse groove mentioned above; elytra much more deeply striate than *testaceous;* thorax and elytra more heavily pubescent; pronotum with much larger, close-set, dish-like punctures .... *punctatus* Lec.

Carabidæ

The introduced European carabid, *Carabus nemoralis* Müll., has apparently reached the Chicago area in its westward movement and specimens were first noticed, crushed on the sidewalks in Chicago, on June 23, 1926. Between July 29 and August 23, seventy individuals (37 ♂, 30 ♀) were taken in Washington Park, Chicago, where they were to be found, generally males and females, in equal numbers and often a single male and female

together, in the soft sod under privet hedges bordering gardens of cultivated roses.

On August 16 an unusually symmetrical monstrosity was taken (Fig. 2 b). This was a male *nemoralis* in which each elytron bore a rounded, elevated nodule one millimeter high and situated one millimeter from the sutural margin.

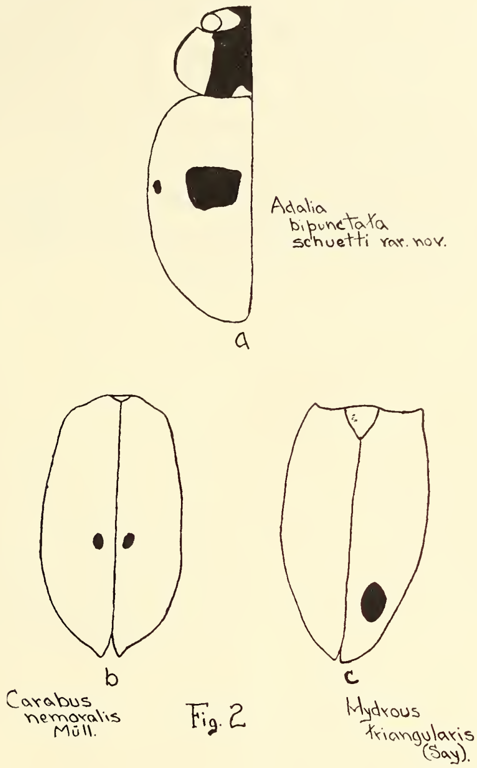

Fig. 2

HYDROPHILIDÆ

Another nodule, similar in shape to those noted for *nemoralis* above, was placed asymmetrically upon the apical third of the right elytron of the large scavenger, *Hydrous triangularis* (Say), (Fig. 2 c), taken June 12, 1927, in Lake Mendota, Madison, Wisconsin, by Mr. J. P. E. Morrison. The nodular swelling was 3 millimeters wide by 4.5 millimeters long.

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EURYMUS EURYTHEME BDV. (LEPID.), AT ITHACA, N. Y., IN 1929

BY AUBURN E. BROWER

The invasion of the region about Ithaca by this butterfly during 1928 was reported by A. B. Klots, Jour. N. Y. Ent. Soc. 37: 41–42, 1929. During the present year, an attempt has been made to follow up the insect in this section to see if it overwintered successfully and the numbers to be found this year compared with the previous year, which was the first time that it has been taken in this region. Strange to say the insect could not be found during the spring months, all of the *Eurymus* collected appear to be *E. philodice.* The first *eurytheme* appeared in July.

The first records for 1929 are: July 6, ♂, Cornell Campus, by writer; July 7, one on Cornell Campus, by W. T. M. Forbes; July 9, I observed 2 ♀ and 3 or 4 ♂ about an alfalfa field at Lower Enfield. Since that time the insect has been on the wing continuously; five or six may readily be seen in an afternoon near town. It appears to be slightly more abundant than last year, so it seems safe to say that the insect has established itself in the Ithaca region. The interesting question is—how does it pass the spring months? The specimens seen have all been of the summer forms. I have just seen an albino ♀ taken by A. G. Richards at Connecticut Hill, September 1.

MORE NOTES ON THE WOOD ENGRAVERS OF NORTH AMERICAN INSECTS

Since the publication of our paper, "Notes on Some Wood Engravers of North American Insects,"[1] additional information has been secured, mainly through the kindness of Dr. L. O. Howard and Mr. Hobart Nichols, and is herewith presented.

Doctor Howard advises us that during his early days in Washington, the artist always drew his figures on the wood block. Riley had just come from Missouri and he too was quite accustomed to drawing on the block. Riley often told Doctor Howard that Macwitz did most of his Missouri figures, and that he was an excellent man and satisfied him perfectly. One of the first things that Riley did when he came to Washington was to look for a good wood engraver because he appreciated the value of good illustrations, and he found H. H. Nichols, of Washington, D. C. Mr. Nichols or his employees really controlled the engraving of insects for the Department of Agriculture until the advent of photo-engraving. Otto Heidemann came after Nichols died.

Henry Hobart Nichols was born in Danbury, Conn., May 10, 1838, and in the beginning of his career, he made all the drawings and engravings for the Medical and Surgical History of the Civil War. He started his apprenticeship with Frank Leslie, the publisher, and then went to the war, serving in a New York regiment. After the war he located in Washington, D. C., and did most of the engraving for the scientific publications of the Government. He was a close friend of Spencer F. Baird, Assistant Secretary of the Smithsonian Institution from 1850 to 1878 and Secretary from 1878 to 1887, and made a large number of ornithological engravings for him—winning a medal at the Centennial Exposition in Philadelphia for his work. In later years he was very successful in establishing a large business in Washington, where he employed six or eight of the leading wood engravers of the country. He contracted for the illustration of all kinds of government reports and was successful in this business until his death in No-

[1] Jour. N. Y. Ent. Soc. Vol. XXXVI, pp. 421–433, 1928.

vember, 1887, which was coincidental with the arrival of photo-engraving. His son, Mr. Hobart Nichols, to whom we are indebted for all the facts about his father, writes, ''My earliest recollection of my father was in our home on L street in Washington. One room of the house was his work-shop. He was essentially an artist both in temperament and appearance. A handsome man—of good physique, dark eyes—and a heavy suit of dark hair which he wore long. He was industrious, often working late into the night while my mother read aloud to him. He was fond of music and painting and often amused himself with the latter. My mother was a great help to him, making many of the drawings on wood which he engraved.''

Miss Marion Cushman, of the Rutgers University Library, called our attention to the insect wood engraving of J. W. Orr in ''The Rhyme and Reason of Country Life,'' edited by Susan Fenimore Cooper and published by G. P. Putnam and Co., in 1854. Chapter XIV of this book, which consists of selections from various poets on the butterfly, the cicada, the grasshopper, the dragonfly, etc., is headed by a decorative engraving of roses, spider-web and butterfly, which is rather indifferently done.

John William Orr was born in Ireland in 1815 and came to this country when a child. He studied engraving in New York and later established the most important engraving business in that part of the country. Some of his work appeared in the publications of the American Tract Society, ''Knickerbocker's History of New York'' (1852), Abbott's ''Life of Napoleon Bonaparte'' (1855), and Strong's ''Illustrated American News'' (1851–52), and Harper's ''Illustrated Shakespeare.'' He died in New York in 1887.—*Harry B. Weiss and Grace M. Ziegler.*

NEW BEES FROM THE MESA VERDE NATIONAL PARK, COLORADO

BY T. D. A. COCKERELL

When we examine the long list of North American bees, it seems that the fauna must be well known. But if we list the recorded localities, it at once becomes apparent that only a few regions have been at all adequately explored for these insects. There are, in fact, large areas from which we know little or nothing. It might be a useful and suggestive undertaking, at some future time, to list the localities from which insects of various orders are particularly to be desired, obtaining the information from various specialists. Then entomologists could take their holidays in this or that place, knowing in advance that every specimen collected would be of scientific interest. In some cases, no doubt, specialists could be found who would promise to work up and record such collections.

The Mesa Verde region, in southwestern Colorado, has hitherto been one of the blank spaces on the map, so far as bees were concerned. Mr. P. R. Franke, one of my students, made a small collection there last summer, and the results, given below, are sufficiently striking. Several of the new species are large and striking insects. Undoubtedly many more remain to be discovered, and a collector who will go there next year may be confident that he will find new and rare species.

How many species of bees are there in North America, or in the world? It is impossible to say, but perhaps a rough estimate may be made in this fashion. Robertson, in the vicinity of Carlinville, Illinois, examined the flowers of 263 genera of plants, and collected 297 species of bees. Perhaps, roughly, we may estimate one species of bee to each genus of insect visited plants. In Colorado, however, the proportion differs, the species of bees very considerably exceeding the number of genera of plants. This accords with the fact that bees are much more numerous and varied in dry regions. On islands it is likely to be all the other

way; thus New Caledonia, with a most remarkable and extensive flora, has only a few bees. Taking all these differences into account, it might be possible to estimate the probable number of kinds of bees in a region. Thus California, with its very peculiar flora, and many dry areas, would be expected to possess a very large fauna of endemic bees, and that is undoubtedly the case. It does not seem probable that the number of species of bees in a locality increases proportionately to the number of species of plants, when these do not represent additional genera. But in adjacent regions, when the same genera are represented by different species of plants, the species of bees may also be expected to differ. Altitude must also be considered,[1] but at present our data in respect to bees are very defective.

Emphoropsis citulus sp. n.

♂. Length about 13.5 mm.; robust, black, with hair of head and thorax above pale fulvous, not mixed with black, of cheeks and sides of thorax long and pure white; front tufted with ochreous, sides of vertex with black hair directed forward; face with long white hair, but black hairs at sides; labrum black, with white hair; mandibles black; tongue extending far beyond labial palpi; eyes black; face marks pale yellow, consisting of clypeus (except broad lateral margins and an inwardly directed point above the middle from lateral bands), large thorn-shaped lateral face marks, and very broad supraclypeal triangular mark; scape with a broad yellow band; third antennal joint comparatively short, shorter than next two together; flagellum rather long, entirely dark; tegulæ black; wings brownish hyaline; second cubital cell nearly square, receiving recurrent nervure a short distance from end; anterior legs with long white hair behind, with some black intermixed; middle and hind femora with black hair, the middle pair with a few pale hairs in front; middle and hind tibiæ and tarsi with silky white hair, some black on inner side; spurs dark brown; abdomen with first two tergites thickly covered with erect ochreous tinted hair; remaining tergites covered with black hair, but a little patch of white at apex; sides of abdomen with some long white hairs.

Mesa Verde National Park, Colorado, July 12, 1929 (*Paul R. Franke*). Closely related to *E. johnsoni* (Ckll.), but easily known by the black hair or abdomen beyond second tergite. The venation shows that it is not the male of *E. mucidus* (Cresson). In my key in Bull. So. Calif. Acad. Sci., 1905, it runs next to *E. murihirta* Ckll., differing by the light-marked scape, and no mixture of black hair on thorax above.

[1] See Lutz, Bull. Amer. Mus. Nat. Hist., XLVI (1922), Art. V.

Anthophora subignava sp. n.

♀. Very large and robust, like *A. ignava* Cresson, which it at first sight appears to be, but distinct by the long creamy-white hair on scutellum and adjacent parts, with a very few dark hairs on scutellum, though the vertex (as in *A. ignava*, but not in *A. porteræ*) has long black hair; first abdominal tergite with very long creamy-white hair; second with shorter erect white hair, and a very little black subapically; margins of the second and third tergites with entire, thin, but rather conspicuous bands of white hair; discs of third and fourth tergites with erect black hair; fifth with much black hair, but sides of third to fifth with much long white hair. Eyes dark grey or black (green in *A. ignava*); flagellum entirely black; third antennal joint very long (about 1.5 mm.); tegulæ black; wings brownish; abdominal tergites distinctly greenish at sides; legs nearly as in *A. ignava*. The distance between the tegulæ is 5 mm., and the wings are nearly 13.5 mm. long.

Mesa Verde National Park, Colorado, May 8, 1929 (*Paul R. Franke*).

Nomada frankei sp. n.

♂. Length about 8.2 mm., anterior wing 6.2; hair of head and thorax pale fulvous above, white below; head, thorax and abdomen with light lemon yellow markings, and no red; mandibles (except apex), labrum, clypeus (broadly separated from lateral marks except below), lateral face marks (very broad below, then rapidly narrowing to a narrow band along orbits to level of antennæ, slightly enlarged at top), and stripe behind eyes below, all yellow; scape greatly swollen, entirely yellow in front, black behind; flagellum stout, bright ferruginous, the first four joints black above; third antennal joint about half length of fourth (more than half on longer side); yellow of thorax confined to tubercles, line on upper edge of prothorax, and a pair of large round spots on scutellum; tegulæ light yellow, with a small brown spot; wings darkened apically, stigma clear red; basal nervure meeting nervulus; first recurrent ending beyond middle of second cubital cell; legs with coxæ and trochanters marked with yellow in front; anterior femora, tibiæ and tarsi yellow in front, red behind, except that femora and tibiæ are yellow at apex, and the femora have a long black band, and the tibiæ a black mark; middle and hind femora red in front and black behind, but apex broadly yellow; middle and hind tibiæ marked with red, black and yellow, their tarsi pale red, the basitarsi with a yellow mark at base; abdomen with six broad entire light yellow bands, the apical margins of the tergites black or dark brown; first tergite black with a broad yellow band, emarginate in middle anteriorly; venter with very broad yellow bands.

Mesa Verde National Park, Colorado, June 22, 1929 (*Paul R. Franke*). Very closely allied to *N. pascoensis* Ckll., of the states bordering the Pacific. It differs by the ordinary (not produced

and pointed) last antennal joint, the black on each side of upper part of clypeus, the very dark green eyes, the immaculate postscutellum, the narrower, feebly notched apical plate of abdomen, etc. It also resembles *N. civilis* Cresson, differing by the coloration of the legs, etc.

Andrena viridibasis sp. n.

♀. Length about 10 mm.; head and thorax black, with front and vertex dark blue, region above front legs shining green, metathorax obscurely blue; tegulæ and legs black; abdomen dullish, without bands, very closely and finely but conspicously punctured, first tergite olive green, the others rich dark blue, the apical depressions concolorous and equally punctured; pubescence entirely black, scopa of hind legs dense and compact; clypeus shining, sparsely but strongly punctured, with a smooth median ridge; third antennal joint about as long as next two together; disc of mesothorax highly polished, with scattered weak punctures; anterior margin of scutellum shining; area of metathorax entirely dull, without evident sculpture; wings hyaline, faintly orange-tinted, with the outer margin broadly dilute fuliginous; stigma ferruginous; nervures rather pale fuscous; basal nervure meeting nervulus; second cubital cell receiving recurrent nervure at middle; second tergite in middle depressed about a third.

Mesa Verde National Park, Colorado, June 17, 1929 (*Paul R. Franke*). A second specimen is somewhat smaller, with the abdomen less brightly colored. This species is in all respects very close to *A. bruneri* Vier. & Ckll., from Wyoming. It differs by the concolorous hind margins of tergites, the shining mesothorax, the dusky nervures, and the position of the first recurrent nervure. The green first tergite is also characteristic. It is also allied to *A. hicksi* Ckll., but the wings are differently colored, the abdomen is much more distinctly punctured, and there is no broad shining space below the anterior ocellus. It may represent no more than a local race of *A. bruneri*, but it seems best to treat it as a distinct species.

Andrena speculifera sp. n.

♀. Length about 9 mm.; black, head and thorax with fulvous hair, brighter and redder above, short on thoracic dorsum; mandibles and antennæ entirely black, tegulæ very dark brown; malar space linear; process of labrum obtusely emarginate, its base with transverse striæ; clypeus convex, highly polished, with widely scattered distinct punctures; facial foveæ narrow, pale fulvous, overlapped by long fulvous hairs; third antennal joint not very long, but as long as next two together; mesothorax dull anteriorly,

but the posterior disc and the scutellum highly polished and shining; area of metathorax entirely dull, without evident sculpture; wings dusky hyaline, darker apically, stigma ferruginous, nervures pale fuscous; basal nervure falling short of nervulus; second cubital cell broad, receiving recurrent nervure slightly before the middle; legs black, with the hind tibiæ and tarsi clear red; scopa of hind tibiæ pale fulvous, very short and subappressed; hair on inner side of hind basitarsi reddish orange; abdomen moderately shining, very minutely, not very conspicuously, punctured; tergites 2 to 4 with dense entire pale fulvous hair bands; apex with pale fulvous tinted hair.

Mesa Verde National Park, August 1, 1929 (*Paul R. Franke*). This could be taken for *A. medionitens* Ckll., but for the much narrower facial foveae and the pale fulvous abdominal bands. It is very like *A. auricoma* Smith, but differs at once in the clypeus, which is similar to that of *A. pronitens* Ckll. The entirely black flagellum separates it at once from *A. montrosensis* V. & C.

Andrena (Trachandrena) abjuncta sp. n.

♀. Length about 11 mm., anterior wing 10.3; black, with black hair, but that of mesothorax, scutellum, postscutellum and fringe of tubercles erect, dense, and creamy-white; depression of second tergite shining, extending nearly to base in middle, those on third and fourth involving nearly a third of tergite in middle; process of labrum large and broadly truncate; third antennal joint rather short, not as long as next two together; facial foveae seen from above dark seal brown, rather broad, separated from orbit by a shining band; antennae and tegulae entirely black; clypeus coarsely and extremely densely punctured, with a slight median ridge visible with a side light, but no trace of a smooth band; surface of mesothorax hidden by hair; scutellum dull and closely punctured; area of metathorax with strong even longitudinal plicae; wings dilute brown, stigma and nervures very dark; basal nervure meeting nervulus; second cubital cell receiving recurrent nervure much beyond the middle; spurs black; abdomen shining, without bands, rather weakly punctured, but raised parts of tergites at sides closely and evidently punctured; tergites without conspicuous erect hair. In all respects very close to *A. swenki* Vier. & Ckll. from Idaho, but dark hair pure black, hair on under side of front femora black; clypeus with no smooth line; foveae darker: tegulae black. It may have to rank as a subspecies of *A. swenki*. The spur on middle tibia is abruptly bent at end, forming a hook.

Mesa Verde National Park, Colorado, July 6, 1929 (*Paul R. Franke*).

Andrena heterura sp. n.

♀. Length about 14 mm.; a species with the aspect of *A. vicina* Sm., with dense creamy white pubescence on head and thorax above, as well as

tubercles, scanty and black on face, with a little white at sides near the antennae (easily overlooked), black on cheeks, pleura, legs and abdomen, mostly dull white on metathorax; process of labrum large, truncate; clypeus densely punctured, without a longitudinal elevation or smooth line, but lower middle with a shining stripe, representing the lower end of a smooth band; antennae and tegulae black, the latter covered anteriorly with pale hair; third antennal joint about as long as next two together; facial foveae broad, very dark brown, going some distance below level of antennae; mesothorax dull, very hairy; area of metathorax without evident sculpture; wings strongly dusky; stigma small, dusky red with a dark margin; nervures dark brown; basal nervure meeting nervulus; second cubital cell broad, receiving recurrent nervure at middle; spurs black; abdomen without bands, no erect dorsal hair; tergites dullish, faintly greenish, very finely and weakly punctured; second tergite depressed about a third.

Mesa Verde National Park, Colorado, June 29, 1929 (*Paul R. Franke*). A peculiar species, running in my manuscript tables to the vicinity of *A. errans* Smith and *A. carliniformis* Vier. & Ckll., but with the abdomen having a dullish, greenish, surface; an approach to the condition of *A. subtilis* Smith. It would not be classed among the metallic species, the green being so obscure as only to be evident on comparison with the pure black of related forms. The type of *A. heterura* had collected two entirely different sorts of pollen, very bright orange on the hind femora, and creamy white on the tibiae.

Andrena (Pterandrena) platyrhina sp. n.

♀. Length about 12.5 mm., anterior wing 10; black, robust, head and thorax with pale fulvous hair throughout; facial quadrangle broader than long; mandibles and antennae black; tongue very short: process of labrum binodose; malar space rather well developed; clypeus rather long, shining, distinctly but not densely punctured, flattened in middle, and with a fine median keel; sides of face with long spreading fulvous hair; third antennal joint about 480 μ long, equal to next two together; facial foveae very broad, light fulvous, very close to orbits; hair of scutellum dense at each side, and very red; mesothorax dull, scutellum slightly shining, finely punctured; postscutellum large; area of metathorax dull and granular, hardly defined; tegulae hairy, very dark brownish; wings dusky, but not reddened; stigma moderate, dark reddish; nervures dark fuscous; basal nervure meeting nervulus; second cubital cell broad, receiving recurrent nervure about middle; legs black, with very pale fulvous tinted hair, orange-ferruginous on inner side of tarsi, floccus on hind femora white, tuft on hind knees warm reddish; spurs ferruginous; abdomen dullish, very finely punctured, second tergite depressed hardly a third, the depression weak; tergites 2 to 4 with

pale fulvous hair-bands, the first two rather broadly interrupted; caudal tuft bright coppery red.

Mesa Verde National Park, Colorado, June 26, 1929 (*Paul R. Franke*). The pollen collected is cream color, the grains elongated, rounded at each end, smooth, with a longitudinal line. They are about 23 μ long. The individual grains appear colorless under the microscope. *A. platyrhina* is much like *A. helianthi* Rob., but is known by the dusky wings, with larger stigma; the longer clypeus, flattened in middle; the much redder hair at apex of abdomen, etc. The hair at apex of abdomen is about as in *A. sayi* Rob.

Andrena (Trachandrena) tardula sp. n.

♀. Length about 8 mm.; black, hair of head and thorax long and abundant, dull white, faintly creamy dorsally; facial quadrangle broader than long; antennae and mandibles black; third antennal joint very short, not much longer than fourth; facial foveae dull white, rather broad; clypeus shining, strongly and densely punctured, with no median ridge or smooth line; front dull, closely punctured and more or less striate; scutellum and disc of mesothorax shining, with distinct well separated punctures; area of metathorax large, dull, with strong irregular plicae, partly Y-shaped, with the fork posterior, the surface between the plicae minutely striate; tegular dark in front, pale reddish behind; wings hyaline; stigma large, dusky reddish, nervures fuscous; basal nervure meeting nervulus; first cubital cell very long, second small, square, receiving recurrent nervure at apical corner; third cubital cell long; legs black, with white hair, creamy white on inner side of hind basitarsi; abdomen shining, finely punctured, hair bands white, that of first tergite thin and poorly developed, of second to fourth well developed and conspicuous; apical region with white hair, a little fulvous at tip, at extreme apex two little tufts of black hair, giving the impression under a lens of a bidentate apical plate.

Mesa Verde National Park, Colorado, August 7, 1929 (*Paul R. Franke*). The date is very late for a *Trachandrena*, but the specimen is quite fresh. It is very close to *A. claytoniae* Rob., which flies in the spring, but the wings are faintly greyish, not reddish, the stigma is darker, the hind tibiae and tarsi are black. The depression of the second tergite does not differ. The stigma is conspicuously larger than *A. daeckei* Vier., which flies in July in Maine.

In addition to the new species, Mr. Franke collected in the Mesa Verde Park last summer the following: *Osmia wilmattae*

Ckll., *O. gaudiosa* Ckll., *Lithurgus apicalis* Cress., *Heteranthidium occidentale* Cress., *Apis mellifera ligustica* Spinola, *Agapostemon texanus subtilior* Ckll., *Proteraner leptanthi* Ckll., *Nomada pecosensis* Ckll. (♀, Aug. 6), *N. crawfordi* Ckll. (♂, Aug. 6), *Bombus morrisoni* Cress., *B. bifarius* Cress., *Halictus trizonatus* Cress., *Andrena argentiniae* Ckll. (June 29 and July 6), *Bombomelecta fulvida* Cress., *Xenoglossodes excurrens* Ckll., *Anthophora neomexicana* Ckll., *A. simillima* Cress., *A. porteræ* Ckll.

NOTES ON DRAGONFLIES OF THE GENUS NEUROCORDULIA

BY WILLIAM T. DAVIS
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In the Bulletin of the Wisconsin Natural History Society, Vol. VIII, p. 174, October, 1910, R. A. Muttkowski described "*Neurocordulia obsoleta clara* n. subsp.," from "one female labelled Alabama in the Brooklyn Institute." He adds: "The entire absence of anal spots on all wings will distinguish this species from other *Neurocordulia.* There is not the slightest trace of the anal spots as found in *N. obsoleta* and *yamaskanensis.*"

In describing *Neurocordulia virginiensis,* Bulletin Brooklyn Entomological Society, Vol. XXII, pp. 155–157, June, 1927, the writer did not refer to the description of *clara* which appeared subsequent to the catalogue of May, 1910. By some it is considered to be synonymous with *obsoleta* Say. We are now able to present a figure, natural size, of the type of *clara,* also reproducing that of *virginiensis* and one of *obsoleta,* for comparison. The wings of *N. yamaskanensis* Provancher, are figured in Entomological News, November, 1908, plate 18, and there is a description by Dr. Hagen in "Psyche," July, 1890, pp. 367, 371. It would appear that there may be four species of *Neurocordulia* in eastern North America.

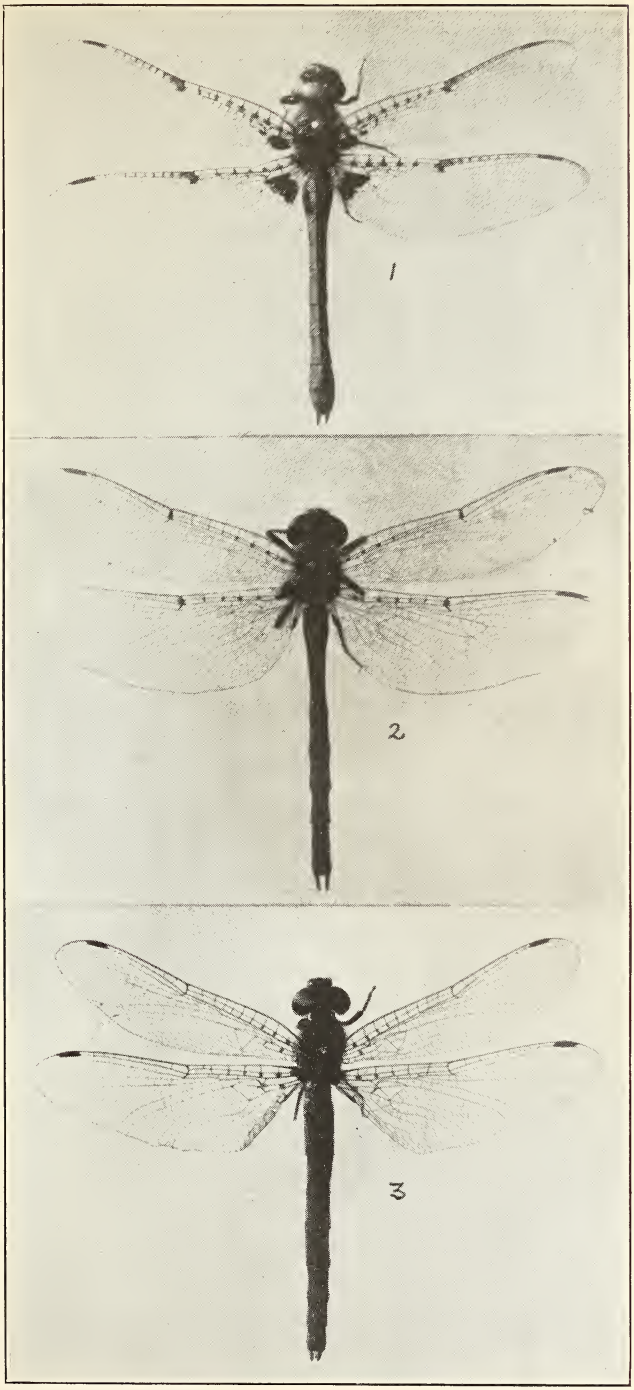
While *virginiensis* resembles *clara* in having less reticulated wings than *obsoleta,* the vein at the lower margin of all four pterostigmata is more thickened, curved and black than in either *clara* or *obsoleta,* which also have the pterostigmata longer. Attention may also be called to the small number of postnodals in *virginiensis,* seven in the left fore wings and six in the right wing. In *obsoleta* and *clara* there are usually nine. In *obsoleta, yamaskanensis* and *clara,* there are in part three rows of cells in the front wing between Cu2 and the hind margin, while in *virginiensis* there are but two. In the hind wing there are three

rows of cells between A2 and the hind margin of the wing in *obsoleta, clara* and *yamaskanensis,* while in *virginiensis* there are but two. The female appendages are as long, or very nearly as long, as segments nine plus ten in *clara,* as stated in the original description, while in *obsoleta* and *virginiensis* they are considerably shorter. The tarsi are fuscous in *obsoleta* and *virginiensis,* while in *clara* they are pale and of the same color as the femora and tibiae.

Two other names appear under *Neurocordulia,* namely *polysticta* Burmeister, stated by Dr. Hagen in "Psyche," 1890, to be a synonym of *obsoleta,* and *molesta* Walsh described in the Proceedings of the Entomological Society of Philadelphia, 1863, p. 254. Dr. Hagen also placed this as a synonym of *obsoleta,* and as Walsh states that all four wings are marked alike and that there is "a square spot upon each of the second series of antecubitals" in the front wing "and a large irregular spot upon the nodus, all pale reddish-brown," it is certain that neither *clara* or *virginiensis* are included.

EXPLANATION OF PLATE VIII

FIGURE 1. *Neurocordulia obsoleta* Say, Cabin John, Md., June, 1910.
FIGURE 2. *Neurocordulia clara* Muttkowski, Type Alabama.
FIGURE 3. *Neurocordulia virginiensis* Davis, Type, Buckingham Co., Va.



NEUROCORDULIA

BOOK NOTICES

Insect Singers, A Natural History of the Cicadas. By J. G. Myers. George Routledge and Sons, Limited, London, 1929, 304 pp., 7 plates, 116 text figures, also bibliography and index.

This book tells what is at present known about cicadas and also gives a lengthy account of man's interest in these conspicuous insects that were written about a thousand years before Christ.

The account of cicadas in art and literature is the subject of the first two chapters and cover thirty-nine pages, but there are quotations from Aristotle and other early observers throughout the book. Chapter IV is on the external structure, V on the internal structure of cicadas, and VI on the sound-organs. Then follow chapters on the classification of cicadas, their evolution, life-history, distribution, relations with other organisms, their feeding-habits, their vertebrate and invertebrate enemies, their relations with man (gastronomic and otherwise), cicada psychology, their behavior, their songs, and lastly chapter twenty-one on methods of collection, preservation and study.

The bibliography covers forty-nine pages and will be very useful, though the author states that it is by no means complete. The index covers eighteen pages.

With its pleasing historical approach to their study, and the thoroughness with which each subject is covered, this book will be among the first to be consulted by those desiring information concerning the ever interesting cicadas that live so long in the dark beneath the surface of the ground, suddenly come forth, split their integument, and produce from active pupae very different looking creatures that directly commence to sing.—Wm. T. Davis.

Studies on the Biology of Kansas Cicadidae. By Raymond H. Beamer. Reprinted from the University of Kansas Science Bulletin. Vol. XVIII, April, 1928. 76 pp. 16 plates.

After treating of such interesting matters as rearing cicadas from the egg to adult, there is a detailed account more or less

complete of fifteen species of cicadas native to Kansas. Among the conclusions reached is that adult cicadas may be transported long distances and kept in live cages for as long as three weeks, singing, mating and ovipositing normally; adults feed frequently by sucking juices from living plants; nymphs feed throughout the greater part of the year, at least, and cannot subsist on annuals; nymphs remain in the same cell if the food is satisfactory, but will burrow extensively if the host dies; the number of segments of the tarsi change from two to one and back to two again during nymphal life; all Kansas cicadas have a life history covering several years, that of *Melampsalta calliope*, the smallest of the Kansas cicadas, is completed in approximately four years.

This important paper has been delayed in appearing, and it is to be regretted that Dr. Myers was thus prevented from including some of the conclusions in his valuable book on the cicadas.—Wm. T. Davis.

THE TERMINAL ABDOMINAL STRUCTURES OF FEMALE INSECTS COMPARED THROUGHOUT THE ORDERS FROM THE STANDPOINT OF PHYLOGENY

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In order that the conclusions concerning the interrelationships of the insectan orders, drawn from the study of one set of structures, might be checked by the study of other structures as well, selected from as widely different portions of the body as possible, I have presented the evidences of relationships furnished by a comparison of the maxillae (Crampton, 1923) and the neck and prothoracic sclerites (Crampton, 1926) throughout all of the orders, including the wingless as well as the winged forms, from the standpoint of phylogeny. To the evidences of relationships from these sources, I would add that gained from a study of the structures of a very different portion of the body, namely, the terminal abdominal structures of female insects.

The terminology employed in this paper is based upon that proposed in a previous paper (Crampton, 1917) but modified by Walker, 1919, whose excellent papers on the genitalia of Orthopteroid insects, together with the one by Chopard, 1920, on the same subject, are the best works on the genitalia of lower insects, while the paper by Tanner, 1927, on the terminal abdominal structures of female Coleoptera, is the most valuable paper dealing with the parts in higher insects. Newell, 1918, has described the abdominal structures of a number of types of insects, but her work is not of great value. The older works of Lecaze-Durthiers, 1853, and Peytoureau, 1895, are not especially important, but the comparison of the parts of the ovipositor of the roach and Lepisma with the parts of a biramous Crustacean appendage by Wood-Mason, 1879, is of considerable interest, and his ideas are not essentially different from those adopted in the present paper.

Starting with the original condition exhibited by the hypothetical Crustacean-like ''Protohexapod'' (or first insect) shown

in Fig. 1, we may trace from such a source first, the type of appendages occurring in the primitive *Machilis*-like insect shown in Fig. 2, next, the slightly more specialized Odonatan type shown in Fig. 3, and lastly, the Orthopteroid type shown in Fig. 4, from which most of the higher forms may be derived. In the hypothetical ''Protohexapod'' or ''Protinsect'' shown in Fig. 1, the limbs of the eighth, ninth and tenth abdominal segments are depicted as biramous, like the two-branched limbs of Crustacea. composed of a basal portion or protopodite, *pr*, an outer branch or exopodite *ex*, and an inner branch or endopodite *en*. As is indicated by the labelling in Fig. 1, the protopodite *pr* of the eighth abdominal limb is to become first a coxite *cx* and then a basivalvula *bv*, while its exopodite *ex* is to become a stylus *st*, and its endopodite *en* is to become a ventral ovipositor-valve *vv*. The protopodite *pr* of the ninth abdominal limb is to become first a coxite *cx*, and then a dorsal ovipositor-valve *dv;* its exopodite *ex* is to become a stylus *st*, and its endopodite *en* is to become an inner ovipositor-valve *iv*. The protopodite *pr* of the tenth abdominal limb is homologous with a coxite *cx* and is to become a paraproct *pp*, while its exopodite *ex* is to become a cercus *ce*, and its endopodite *en* is to become the so-called ''paraprocess'' *ps*.

The diagram shown in Fig. 2 differs so little from *Machilis* itself (Fig. 6) that the latter might equally well be taken to illustrate the first stages in the evolution of the original insectan condition from the hypothetical stage shown in Fig. 1, but the markings in the diagrams make it a little easier to follow the comparisons of the parts in the figures. In passing from the stage represented in Fig. 1 to that shown in Fig. 2, the following changes take place. The protopodite *pr* of the limb borne on the eighth sternite 8^s of Fig. 1 becomes the coxite *cx* of the limb borne on the eighth sternite 8^s of Fig. 2, while the endopodite *en* of the limb of the eigth segment in Fig. 1 becomes the ventral valve of the ovipositor *vv* of Fig. 2, and the exopodite *ex* of the limb of the eighth segment in Fig. 1 becomes the stylus *st* borne on the eighth coxite *cx* in Fig. 2.

The following changes take place in the biramous limb of the ninth segment of Fig. 1. Its protopodite *pr* becomes the coxite *cx* of the ninth segment in Fig. 2; its exopodite *ex* becomes the

stylus *st* of the ninth coxite *cx* in Fig. 2; and its endopodite *en* becomes the inner valve *iv* of the ovipositor in Fig. 2. The coxite *cx* of the ninth segment in Fig. 2 becomes greatly elongated, and is the precursor of the dorsal valve of the ovipositor *dv* of other figures.

The biramous limb borne on the tenth segment of Fig. 1 becomes modified as follows in Fig. 2. Its protopodite *pr* of Fig. 1 becomes the paraproct (or parapodial plate) *pp* of Fig. 2, which is homodynamous, or serially homologous, with the coxites of the preceding segments; its exopodite *ex* of Fig. 1 becomes the cercus *ce* of Fig. 2; and its endopodite *en* of Fig. 1 is lost in Fig. 2 (but traces of this structure are retained in the paraprocessus *ps* of Fig. 4).

In the Entomological News for 1921 (Vol. 32, p. 257) I have given the reasons for the earlier suggestion (*e.g.*, in the Canadian Entomologist, 1920, Vol. 52, p. 178, etc.) that the cercus represents the endopodite rather than the exopodite, namely, that in the uropods of Crustacea such as the Isopods *Leptochelia* and *Cubaris,* the exopodite becomes reduced and is eventually lost, while the endopodite is retained and is borne on the protopodite in exactly the same way that the cercus of lower insects is borne on the paraproct or parapodial plate homologous with the protopodite; and embryologists have shown that the cerci develop exactly as the legs do—and the legs represent the endopodites (not exopodites), so we would expect that the cerci also represent endopodites, since they develop like the legs, and the condition in the Crustacean uropods indicates that the endopodites (not the exopodites) persist to form the cerci. Furthermore, if the cerci are modified exopodites they are homologous with the styli, and the styli are not multiarticulate in insects, while the endopodites forming the intermediate and ventral valves *iv* and *vv* of the ovipositor of *Machilis* (Fig. 6) show signs of being multiarticulate (though perhaps these are merely secondary markings on the valves), so that we would expect the multiarticulate cerci to be homologous with the "multiarticulate" valves rather than with the styli, and thus represent endopodites. While most of the evidence is thus on the side of considering that the cerci represent endopodites (as I formerly maintained), it has always

seemed that the last pair of legs would be twisted into a most unnatural position if the cerci were made to occupy the position of endopodites, and I have therefore suggested in the present paper that the cerci may possibly represent exopodites, although I would not insist upon this interpretation of them.

Heymons and other embryologists consider that the cerci *ce* are appendages of the eleventh (not the tenth) segment of the abdomen, and they consider that the paraprocts *pp* represent the widely divided halves of the eleventh sternite, instead of their representing the protopodites (or coxites) of the limbs borne on the hinder margin of the tenth sternite. It should be noted, however, that the modified protopodite, or coxite, of the eighth abdominal segment is borne on the posterior margin of the eighth sternite in the Odonatan shown in Fig. 9, where the protopodite or coxite bears the label *bv* or *8cx*. This eighth coxite or protopodite *8cx* projects backward beneath the segment behind it exactly as the protopodite or coxite of the tenth segment does in Fig. 1, where the coxite in question bears the labels *pr* or *cx;* and since the embryologists were not aware of the fact that the coxite or protopodite frequently projects backward beneath the segment behind it, they apparently mistook the coxite or protopodite of the limb of the tenth segment for the divided eleventh sternite, and consequently mistakenly interpreted the paraprocts *pp* as the eleventh sternite divided into widely and unnaturally separated halves—a condition which does not occur in any sternal region of which I have ever heard! It should also be noted that Heymons admits that in the Odonata the cerci *ce* of Fig. 9 develop as appendages of the tenth segment instead of the eleventh segment, but in this case he thinks that the cerci must be something else, despite the fact that they occupy the exact position of the cerci of other insects and every one who has studied them recently regards them as true cerci, without exception. Under these conditions, it would appear that the embryologists have not understood the true nature of the cerci, and there is every reason to suppose that the cerci, and the paraprocts which bear them may represent appendages of the tenth abdominal segment, as described above.

In Fig. 3, the further modifications of the appendages of the eighth, ninth and tenth abdominal segments, met with in the Odonata, are diagrammatically portrayed, although here again (as in the preceding figure) the diagram is just like the figure of the insect itself (as may be seen by comparing Fig. 3 with Fig. 9) and might therefore be considered superfluous, but I think it is easier to compare the parts throughout a series of figures if homologous parts bear the same type of markings; and anything which serves to make a difficult subject more easily understood is not to be despised! In Fig. 3, the basivalvula *bv* represents the coxite *cx* of the limb of the eighth segment in Fig. 2, or the protopodite *pr* of the limb of the eighth segment in Fig. 1. The ventral valve of the ovipositor *vv* of Fig. 3 represents the ventral valve of the ovipositor *vv* in Fig. 2 (although the ventral valve is borne distally in Fig. 3 and "baso-laterally" in Fig. 2) or the endopodite *en* of the limb of the eighth abdominal segment in Fig. 1. When the protopodite or coxite of the limb of the eighth segment (*pr* and *cx* of Figs. 1 and 2) becomes a basivalvula *bv* of Fig. 3, it loses its exopodite or stylus (*ex* and *st* of Figs. 2 and 1).

The dorsal valve of the ovipositor *dv* in Fig. 3 represents the elongated coxite of the ninth segment *cx* of Fig. 2 (which in turn represents the protopodite of the ninth limb *pr* of Fig. 1) and the dorsal valve *dv* of Fig. 3 still bears at its distal end a reduced stylus *st*, representing the stylus *st* of Fig. 2 and the exopodite *ex* of Fig. 1. The intermediate valve of the ovipositor, labelled *iv* in Fig. 3, is much shorter than the intermediate valve *iv* in Fig. 2, but, like it, the intermediate valve *iv* of Fig. 3 represents the endopodite *en* of the limb of the ninth segment in Fig. 1.

The cercus *ce* is borne "dorso-laterad" of the paraproct *pp* in Fig. 3, having shifted its position from the distal end of the paraproct *pp* in Fig. 2. As was pointed out in a previous paper (Crampton, 1921) the endopodite of the uropod of such isopods as *Cubaris* shifts about, exactly as the cercus of the Odonata does, and it is quite possible that the cercus represents an endopodite instead of an exopodite (*ex* of Fig. 1) as was mentioned above.

The eleventh tergite *sa* does not bear a terminal appendage (telappendix or "telite") in the adult Odonatan shown in Fig. 3,

but in immature damselflies the eleventh tergite or suranale *sa* bears a median dorsal gill-plate homologous with the structure labelled *ti* in Fig. 2, although the structure *ti* is not plate-like, but is a multiarticulate "telofilum" in *Machilis* (*ti* of Fig. 6).

In Fig. 4 (which is based largely upon Fig. 58 of *Grylloblatta*) the following changes take place. The basivalvula *bv*, which represents a modified coxite *cx* (Fig. 2) or protopodite *pr* (Fig. 1) of the eighth segment, is greatly reduced in Fig. 4, but still occupies its normal position at the base of the ventral valve *vv* (or modified endopodite). The basivalvula *bv* has lost its stylus (*st* of Fig. 2, or modified exopodite *ex* of Fig. 1) and becomes more closely associated with the valvifer *vf* than in the preceding figures.

The valvifer *vf* of Fig. 4 is the modified lateral region of the ninth sternite 9^s of Figs. 3, 2 and 1, which, in the higher forms, is represented by a sclerite at the base of the dorsal and inner valves of the ovipositor. The dorsal valve of the ovipositor *dv* has lost most of its coxite character in Fig. 4 (compare *dv* of Fig. 3, or *cx* of Fig. 2—or *pr* of Fig. 1) along with the stylus (*st* of Fig. 3) which is borne on the end of the dorsal valve only in the immature stages of *Grylloblatta*. The inner valve *iv* of the ovipositor is a little more like an ovipositor-valve in Fig. 4, and does not greatly suggest its origin as an endopodite (*en* of Figs. 1 and 2) of the limb whose protopodite or coxite became the dorsal valve.

The appendages of the tenth segment in Fig. 4 represent a combination of characters preserved in *Rhipipteryx* (Fig. 85) and *Grylloblatta* (Fig. 58), and the paraproct *pp* (i.e., a modified coxite or protopodite labelled *cx* and *pr* in Figs. 2 and 1) is depicted as having a paraprocess *ps* (possibly representing the endopodite *en* of Fig. 1) as well as a cercus *ce* (possibly representing the exopodite *ex* of Fig. 1). While it is quite evident that the paraproct *pp* is a modified protopodite or coxite (*pr* and *cx* of Figs. 1 and 2), the homologies of the appendage *ps* are not so clear, and the process *ps* may represent an exopodite instead of an endopodite, in which case the cercus *cs* would then represent an endopodite instead of an exopodite, and the whole matter is evidently in need of further study, to determine which struc-

ture represents an exopodite and which represents an endopodite. The eleventh tergite *sa* apparently unites with the tenth tergite *ep* in the type of Orthopteroid insect depicted in Fig. 4.

The extremely primitive character of the terminal abdominal structures of *Machilis* (Figs. 6 and 2) is fully in keeping with the general primitive character of the other structures of this insect, and clearly indicates that the Thysanuroids (including the Lepismatidæ also) are the nearest living representatives of the original "Protohexapoda" (Fig. 1) in addition to furnishing us with the Apterygotan types which approach the lowest representatives of the Pterygota the most closely—as is shown (among other things) by the fact that the multiarticulate telofilum *ti* borne on the end of the suranale *sa,* and the multiarticulate cerci *ce* borne at the tip of the paraprocts *pp* of *Machilis* (Fig. 6) clearly lead to these types of structures in the Ephemerid Pterygota (Fig. 26), while the stylus-bearing, valve-like, ninth coxite *9cx* of *Machilis* (Fig. 6) is clearly the prototype of the stylus-bearing, coxite-like, dorsal valve of the ovipositor *dv* of the Odonata (Fig. 9), which are the most primitive Pterygota having this type of ovipositor.

The Lepismatidæ were very evidently derived from *Machilis*-like forebears, and the terminal abdominal structures of such Lepismatids as those shown in Figs. 13 and 17 clearly exhibit adumbrations of the conditions later reappearing among the Pterygota, in that the ovipositor valves and cerci of these Lepismatids become shortened, and resemble these structures in the Pterygota more closely than *Machilis* does. In the nature of the mouthparts, thoracic structures, etc., the Lepismatids likewise approach the lower Pterygota (ephemerids, etc.) very closely, and they are apparently the nearest living representatives of the types ancestral to the Pterygota.

The terminal segments of the Japygidæ (Fig. 14) are so extremely similar to those of the Campodeidæ (Fig. 18) that there can not be the slightest doubt that these insects belong in the same order, Dicellura. In both Japygidæ and Campodeidæ (Figs. 14 and 18) the styli *st* of the seventh abdominal segment are borne on a region *cx* which represents the coxites which have united with the sternite 7^s; and the proportions of the following

segments, which have lost the styli in both insects, are similar in both. The cerci *ce* are borne in the same way on the tenth segment of both insects; and some Japygids, such as those shown in Fig. 23, have segmented cerci *ce,* so that the lack of segmentation in the cerci of some Japygids does not indicate that they belong in another order different from that containing the Campodeidæ (with many-segmented cerci), any more than the fact that some roaches have unsegmented cerci while others have cerci with many segments would indicate that these different roach types belong in separate orders. The head and abdominal structures of the Dicellura are obviously too modified to represent the ancestral condition for insects in general, and the Thysanuroids are evidently far more primitive than the Dicellura (Japygids and Campodeids) in these, and other respects. The fact that the Dicellura have retained traces of the coxites and styli, cerci, etc., would indicate that their ancestors were like the Thysanuroids (*Machilis,* etc.) in these respects; but the nature of the head and entognathous mouthparts, etc., would indicate a closer relationship to the other entognathous Apterygota such as the Collembola and Protura (although these also may have been descended from *Machilis*-like forebears).

The abdomen is so greatly reduced in the Collembola, that it is impossible to draw any definite conclusions concerning the relationships of the order from a study of the terminal abdominal structures. In the males of some Collembola, such as the one shown in Fig. 22 there occurs a median appendage *ti,* which may possibly represent the median terminal appendage *ti* of Fig. 1; and the paired appendages labelled *ce* in Fig. 22 may possibly represent cerci. If the Collembola are descended from precursors provided with a median terminal appendage and cerci, such ancestors were probably "synthetic" forms resembling Protura, Dicellura and Thysanura in various features of the body. The mouthparts of the Collembola resemble those of the Dicellura in some respects, but the general features of the head and mouthparts of the Collembola are more like those of the Protura, and the more direct ancestors of the Collembola were probably like the Protura.

The abdomen of a typical Proturan is composed of twelve segments (a post-embryonic increase in the number of segments

increases the nine segments of the immature forms to twelve segments in the adults). The three basal abdominal segments bear modified limbs, but the terminal segments are devoid of cerci and other appendages excepting the eleventh segment (Fig. 11) which bears a pair of appendages of undetermined homologies. These appendages are shown enlarged in Fig. 51, and they may possibly represent coxites with styli. The Protura differ from other insects (which usually have the genital opening of the female in the posterior region of the eighth segment) in having the opening of the genital organs in the posterior region of the eleventh segment. Although the Protura are rather primitive in many respects, they are so different from most of the other Apterygota, that they must be regarded as an early offshoot from the original ''Protohexapod'' stock from which the Collembola, Dicellura and Thysanura were also derived. As was mentioned above, the head and mouthparts would indicate that the closest relatives to the Protura, among the Apterygota, are the Collembola.

The resemblance of the Ephemerids (Fig. 26) and Odonata (Fig. 9) to the Thysanuroids (Figs. 6, 13 and 17) has already been mentioned. The Ephemerids (Fig. 26) have lost the ovipositor evidently present in their ancestors (unless the trough-like structure of the eighth segment of the Ephemerid shown in Fig. 20 represents the united ventral valves); but the cerci *ce* and ''telofilum'' *ti* of the Ephemerids (Fig. 26), borne at the distal end of the modified coxites *pp* and suranale *sa*, are strikingly similar in character (and in the manner in which they are borne on the plates to which they are attached) to these structures in the Thysanuroids (Fig. 6). The Odonata (Fig. 9), on the other hand, have retained the ovipositor which the Ephemerids have lost, and the Odonatan ovipositor such as the one shown in Fig. 9 is extremely like the Thysanuroid ovipositor shown in Fig. 6, in having a coxite-like, dorsal valve *dv* bearing a well-developed stylus *st*. Immature damselflies have a median plate-like gill, homologous with the median terminal appendage *ti* of the Ephemerid shown in Fig. 26, or the ''Protohexapod'' shown in Fig. 1; and this median, plate-like gill is borne at the tip of a suranale, while the lateral plate-like gills of the damselfly

"larvæ," which are homologous with cerci, are borne at the tips of paraprocts (see Fig. 9, Plate V of Ent. News, Vol. 32, 1921) like the cerci of Ephemerids (Fig. 26) and Thysanuroids (Fig. 6) which have retained the ancestral condition in these structures (Fig. 1). The presence of the median terminal structure *ti* in Ephemerids (Fig. 26) and damselfly "larvæ," and the manner in which the structures homologous with the cerci are borne on the paraprocts, show that the two groups of insects are related to each other more closely than they are to other Pterygota; and the character of the terminal abdominal structures shows that they are the nearest living representatives of the first Pterygota to be derived from Thysanura-like forebears (which are the most like the primitive "Protohexapod" type shown in Fig. 1). The relationship of the Odonata to the Ephemerida is indicated by the fact that in both of them the maxillary galea and lacinia unite in a peculiar fashion, and there is a marked resemblance in the prothoracic sclerites of the two groups. The strongest point of resemblance between the Odonata and Ephemerida, however, is to be found in the manner of holding the wings at rest. Both belong to the "Archipterygota" or insects which have preserved the old archaic method of holding the wings outstretched from the body when at rest (see Crampton 1924, 1928, etc.), while other winged insects have developed the ability to lay the wings back along the abdomen, or to hold them roof-like above the abdomen, in repose (i.e. they are "Neopterygota").

The Plecoptera, Embiids, Dictyoptera (Blattids and Mantids), Isoptera, Dermaptera, Orthoptera (Saltatoria and Grylloblattids) and Phasmids belong to the Orthopteroid insects which are derived from the common Protorthopteron-Protoblattid stem, and the Blattids, Mantids and Isoptera have departed the least from this common stem, but the Plectoptera have also retained many primitive features.

The general appearance of the terminal abdominal structures of the Plecoptera (Figs. 21, 19, 5, etc.) might suggest that the Plecoptera were derived from Ephemerid-like forebears; but a study of the head and thoracic sclerites, and the wings in particular, indicate that the Plecoptera arose from Protorthopteroid ancestors in the common Protorthopteron-Protoblattid stem, and

their closest relatives are the Embiids, as is also indicated by the details of their abdominal structures. Thus the cerci *ce* of the Plecopteron shown in Fig. 21 are not borne at the tips of the paraprocts *pp* as they are in the Ephemerid shown in Fig. 26, for example, but the cerci *ce* in Fig. 21 (Plecopteron) are like those of the Embiid shown in Fig. 24 in their relation to the paraprocts *pp,* and the relation of the suranale *sa* to the tenth tergite *ep,* as well as the general character of the genital opening of the female, etc., is essentially the same in both Plecoptera (Fig. 21) and Embiids (Fig. 24).

In this connection, I would call attention to the presence of what appears to be a spermatophore *s* protruding from the genital opening of the primitive Plecopteron shown in Fig. 21, and if the structure in question is really a spermatophore, the occurrence of such a structure in Plecoptera would be an added proof of the relationship of the Plecoptera to the Orthoptera which characteristically develop a spermatophore at the time of mating. In fact, all of the anatomical details and the fossil remains of the Plecoptera clearly indicate that they should be placed next to the Embiids in the Orthopteroid group; and it is amazing that anyone at all conversant with the facts should group the Plecoptera with the Ephemerids and Odonata, as is usually done in the textbooks which follow the antiquated views of a century ago, utterly out of step with, and oblivious to, the march of progress in understanding the relationships of the insectan orders in recent times.

There is, I think, no dispute that the Embiids are related to the Orthopteroid insects, and the terminal abdominal structures fully confirm the evidence of relationship to the Orthopteroids indicated by other features of the body. The tenth tergite 10^t, the suranale *sa* and the paraprocts *pp* of the Embiid shown in Fig. 24 are like those of the Orthopteron shown in Fig. 106; and some Orthopterists like Giglio Tos have even gone so far as to assert that the mole cricket *Cylindracheta* shown in Fig. 106 might be an Embiid! In pointing out that *Cylindracheta* is a true mole-cricket in every respect (Crampton, 1928) I would not minimize the evident relationship between the Embiids and Orthoptera; and the similarity in the terminal abdominal struc-

tures of the Plecoptera, Embiids and Orthoptera doubtless indicates that all three orders were derived from a common Protorthopteroid ancestry in the common Protorthopteron-Protoblattid stem. The Embiids and the Plecoptera have apparently lost the ovipositor characteristic of the ancestral forms, unless the posterior processes of the eighth sternite of the Plecopteron shown in Fig. 89 represent vestigial ventral ovipositor valves which have fused with the sternite.

The Blattids, Mantids and Isoptera form a compact group of Orthopteroid insects which have departed but little from the ancestors of all of the Orthopteroid forms in the common protorthopteran-Protoblattid stem. The Odonata among the lowest Pterygota (Archipterygota) approach much more closely than the Ephemerids do to the common Protorthopteran-Protoblattid stem, in that the Odonata (Fig. 9) have a coxite-like dorsal ovipositor valve *dv* bearing a stylus *st;* and a study of the immature stages of the Blattids (Fig. 45) and Mantids (Fig. 41) and the soldier caste of the primitive termite shown in Fig. 49 clearly indicates that the ancestral type (from which the Protoblattids have departed the least) doubtless had a coxite-like dorsal ovipositor valve *dv* of Figs. 41, 45 and 49, bearing a stylus *st* at its apex. In the winged stages, however, of these Mantids (Fig. 27), primitive termites (Fig. 32) and Blattids (Fig. 35) the dorsal valve of the ovipositor *dv* is no longer like a coxite *cx* and has lost the terminal stylus *st* present in the immature stages of these insects shown in Figs. 41, 45 and 49. When the protopodite or coxite of the ninth segment becomes modified to form the dorsal valve *dv* of the ovipositor of the insects shown in Figs. 27, 32 and 35, its exopodite or stylus is lost, and its endopodite forms the inner valve *iv*. The ventral valve *vv* of the ovipositor is formed by the modified endopodite of the limb of the eighth segment, whose coxite becomes reduced to form the basivalvula *bv* of Fig. 27, and its exopodite or stylus is lost. The basivalvula of the roach shown in Fig. 35 is reduced to a small structure in the antero-basal region of the ventral valve *vv,* but the valvifer or modified lateral sclerite of the ninth sternite *vf* at the base of the dorsal valve *dv* is very large in the roach shown in Fig. 35, and the valvifer *vf* is also quite well

developed in the termite shown in Fig. 32 and the Mantid shown in Fig. 27. The details of the ovipositor of the roach are discussed in Psyche, 1925, Vol. 32, p. 195, and need not be further considered here.

Mastotermes (Fig. 32) is the only known termite having a well developed ovipositor, and the unexpected occurrence of such a structure in this termite clearly indicates the close relationship of these termites to the roaches and Mantids (Crampton, 1923 and 1920). Even in such a primitive termite as *Archotermopsis* (Fig. 30) the ovipositor is reduced to the vestigial ventral valves *vv*, and in all other termites of which I have any knowledge the ovipositor is completely lost, so that the termites resemble certain Orthoptera such as the Gryllotalpidæ (Fig. 36) in tending to suppress the ovipositor (see Fig. 106) and there are many features of termite anatomy that indicate that the termites approach very close to the Protorthopteroid ancestors of the Orthoptera in the common Protorthopteron-Protoblattid stem (note also the character of the segments of the cerci *ce* of the termite shown in Fig. 30 and the primitive Orthopteron shown in Fig. 53), although of course the closest affinities of the Isoptera are with the Mantids and Blattids, all of which were descended from Protoblattid-like ancestors in the common Protorthopteran-Protoblattid stem. The large paraprocts *pp* which project free in the Blattids (Fig. 35) termites (Fig. 32) and Mantids (Fig. 27), and the development of the tenth tergite in Figs. 27, 32 and 35, are features which indicate a close relationship between the Blattids, Mantids and Isoptera; and the peculiar development of the seventh sternite[1] which projects backward forming a hypogynium *hg* hiding the reduced sternite 8^S and most of the ovipositor in the Blattids, Mantids and Isoptera shown in Figs. 35, 32 and 27, are striking features which add to the evidence from other sources indicating the close affinities of these insects.

[1] Since there is a tendency to apply the terms sternites, tergites, etc., to the subdivisions of the sternum, tergum, etc., of the thoracic and other segments, instead of using these designations to refer to the sterna, terga, etc., of the abdominal region alone, I would suggest that the terms urosternum, urotergum, etc., be employed to designate the sternum, tergum, etc., of the abdominal segments.

In suppressing the suranale (*sa* of Fig. 36, etc.) and in reducing the eighth sternite (8^s of Fig. 32) these Blattids, Mantids and termites differ from the insects more closely related to the Orthoptera, and the ovipositor is usually not so well developed in the Blattids, Mantids, etc., as it is in most Orthoptera, although the ovipositor of such a Mantid as the one shown in Fig. 27 has well developed basivalvulæ *bv* and valvifers *vf* and is more elongate than the ovipositor of the Blattids, etc., thus suggesting the beginning of an elongated ovipositor with well developed basivalvulæ, valvifers, etc., characteristic of such primitive Orthoptera as the one shown in Fig. 58, although the Grylloblattid there figured is clearly an Orthopteron, and not a member of the compact group including the termites, roaches and Mantids.

The Dermaptera are most puzzling insects, having affinities with all of the Orthopteroid insects, but more particularly with the Orthoptera and Phasmids on the one side, and the termites, Blattids and Mantids on the other. The Dermaptera agree with the Mantids, Blattids and termites (Figs. 27, 32 and 35) in having the seventh sternite 7^s prolonged backward over the reduced eighth and ninth segments (as in the Dermaptera shown in Figs. 56, 55 and 54), and it is quite possible that the Dermaptera should be grouped with the Isoptera, Blattids and Mantids. On the other hand, the development of the suranale *sa* in the Dermaptera (Figs. 55, 57, etc.) is more like that of the Orthoptera (*sa* of Fig. 106) and the Phasmids (Fig. 59) which are closely allied to the Orthoptera; and the cerci *ce* tend to shift dorsad of the paraprocts *pp* in the Dermaptera (Figs. 54 and 55) as they do in many Orthoptera (Figs. 58 and 61). The segmented "larval" cerci *ce* of Fig. 60, which precede the single-segmented cerci of the adults in such Dermaptera as *Diplatys*,[2] etc., are cylindrical and resemble the cerci of such primitive Orthoptera as *Grylloblatta* (Fig. 53) somewhat more than they do the cerci of the typical Blattids and Mantids; and the tendency to reduce the cerci to a single segment exhibited by all

[2] Compare also the appendage *ce* of the Coleopterous larva shown in Fig. 16. The actual homologies of these cerci-like appendages of Coleopterous larvæ have not been definitely determined.

adult Dermaptera, together with the tendency to develop mesal prongs, etc., on the cerci, are tendencies occurring in many Orthoptera (and Phasmids), and are therefore more characteristic of the Orthoptera and Phasmids than of the Blattids and Mantids, so that on the whole the closest affinities of the Dermaptera are probably with the Orthoptera and Phasmids—as I have indicated in comparing the head and other structures of the Dermaptera with the primitive Orthoptera such as *Grylloblatta* (Crampton, 1926). Only a few Dermaptera such as *Kalocrania* and *Echinosoma* (Fig. 55) have an ovipositor, and in them the inner valves are apparently atrophied. Most Dermaptera have a small sclerite *ti* of Fig. 57, behind the peculiarly developed suranale *sa,* and it is possible that the small posterior sclerite may represent a modified ''telite'' like that labelled *ti* in Fig. 1; but I am more inclined to consider that the sclerite in question in the Dermaptera is merely a demarked posterior region of the eleventh tergite *sa*—although some investigators regard it as a telson-like tergite behind the eleventh tergite.

It is really very disheartening that in this age of scientific progress, recent textbooks like Schroeder's ''Handbuch der Entomologie'' (Bd. III by Handlirsch, 1925) should perpetuate the utterly baseless and discredited view that *Hemimerus* represents a distinct ''order'' the ''Diploglossata,'' the very name of which was born of a misconception by Saussure 1879 and Meinert 1880, who erroneously supposed that the hypopharynx and paragnaths of *Hemimerus* (which are exactly like the same structures in other Dermaptera) represented a second under lip unlike anything occurring in other insects, and therefore the possessors of such an unheard-of structure should be grouped in a separate order, the ''Diploglossata''! Comstock, 1924, likewise insists that *Hemimerus* belongs with the ''Orthopteroid Insects of Uncertain Kinship,'' and in his ''Introduction to Entmology'' he places *Herimerus* far from its rightful position in the order Dermaptera, with the Odonata, Hemiptera and many other orders intervening between his treatment of *Hemimerus* and that of the rest of the Dermaptera, thus giving the student an entirely erroneous conception of what is actually known concern-

ing the affinities of *Hemimerus*. In treating of the character of the neck and prothoracic sclerites throughout the orders of insects, I called attention (Crampton, 1926) to the striking resemblance of *Hemimerus* to the rest of the Dermaptera not only in the general make-up of the underlip with its transverse gular sclerite exactly like the type of underlip peculiar to and characteristic of all Dermaptera but also in the nature of its cervical sclerites and particularly the prosternal and propleural sclerites which in *Hemimerus* are exactly like those peculiar to and characteristic of all other Dermaptera; and in the present paper I would emphasize the fact that the terminal abdominal structures of *Hemimerus* are exactly like those peculiar to and characteristic of the Dermaptera, thus indicating that in all of its important features *Hemimerus* is an out-and-out Dermapteron, and there should not be the slightest doubt in the mind of any one of this fact, if he will only consider the available evidence. In *Hemimerus* (Fig. 54) the seventh segment, with its enlarged sternite 7^s projects backward over the reduced eighth and ninth segments exactly as in the Dermapteron shown in Fig. 55; the tenth tergite *ep* and suranale *sa* of *Hemimerus* (Fig. 54) are exactly like these peculiar structures in the Dermapteron shown in Fig. 56; and the relation of the single-segmented cerci *ce* to the peculiar paraprocts *pp* in *Hemimerus* (Fig. 54) is like that obtaining in these structures in the Dermapteron shown in Fig. 55—and many Dermaptera have cerci as long as those of *Hemimerus*. In fact there is no structure in *Hemimerus* that upon analysis is not found to be more Dermapteron than anything else, and it is most astonishing that the systematists will not avail themselves of the knowledge that every morphologist has, concerning the true position of *Hemimerus* within the order Dermaptera!

The Grylloblattidæ are the most primitive representatives of the Orthopteroid superorder "Panorthoptera," comprising the true Orthoptera (including *Grylloblatta*) the Phasmids and the Dermaptera; and the affinities of *Grylloblatta* have been much discussed with varying emphasis upon certain of its "synthetic" features indicating an approach to other Orthopteroid groups in its structural details. Walker, 1919, however, is mistaken in stating on page 272 that I have ever placed *Grylloblatta* in any

group other than the "Panorthoptera," since I have always grouped *Grylloblatta* in the superorder "Panorthoptera," as any one may see who has read the papers in which I have endeavored to emphasize the synthetic nature of *Grylloblatta* by indicating its approach to other forms in its structural details, while at the same time I have stressed the fact that *Grylloblatta* is either an out-and-out Orthopteron, or occupies a position at the base of the line of descent of the true Orthopters. A summary of the reasons for placing *Grylloblatta* in the order Orthoptera is given in a paper (Crampton, 1927) treating of the abdominal structures and affinities of the family Grylloblattidæ, and the discussion there given need not be repeated here.

The occurrence of styli-bearing coxites *dv* (which lose the styli and develop into dorsal ovipositor-valves in the adults) in nymphs of such primitive Orthoptera as *Grylloblatta* (Fig. 50), *Tettigonia* (Fig. 38) etc., clearly indicates that such Orthopteroids were descended from ancestors like those of the immature Blattids, Mantids and soldier termites shown in Figs. 41, 45 and 49, which have similar styli-bearing coxites in their nymphal stages. The ancestors of the Orthoptera in question were apparently Protorthopteroid forms, in the common Protorthopteran-Protoblattid stem, giving rise to the lines of descent of the Orthoptera, Phasmids, and possibly the Dermaptera also. Of these, the Orthoptera and Phasmids differ from the Blattids, Mantids and Isoptera (i.e., the Panisoptera) in that the eighth sternite 8^s is large in many Orthoptera (Figs. 106 and 36) and Phasmids (Figs. 59 and 52), and is not overlapped by the seventh sternite 7^s as is typically the case in the Blattids, Mantids and termites (see Figs. 27, 32 and 35). The Dermaptera, however, (Figs. 54 and 56) would agree with the Blattids, etc., rather than with the Orthoptera and Phasmids, in the development of a posteriorly projecting seventh sternite covering the reduced eighth sternite. Primitive Phasmids, such as *Timema* (Fig. 59) have a suranale *sa* very like the suranale *sa* of the primitive Dermapteron shown in Fig. 55, and the large tenth tergite 10^t or epiproct *ep* is very similar in both of these insects. The development of a downward projecting suranale *sa* in the Dermaptera (Figs. 55 and 57) is more of an Orthopteroid feature (Fig. 106,

sa) than a Blattoid feature (Figs. 35, 32 and 27) since the suranale is not chitinized in the Blattoid forms. Similarly, the cerci of Phasmids and Dermaptera (and Orthoptera also) are one-segmented and frequently bear median prongs and other projections, so that the terminal features of Phasmids, Orthoptera and Dermaptera indicate a rather close relationship between these forms. The Phasmids (Figs. 59 and 52) agree with the Orthoptera (Figs. 61, 58 and 106) in having a large well developed eighth sternite 8^s not overlapped by the seventh sternite (as in Blattoids); and the nature of the head and thoracic sclerites clearly indicate that the Phasmids are the next of kin to the Orthoptera, although certain investigators seem to think that the Phasmids are more closely related to the Mantids.

The primitive Orthoperan ovipisitor shown in Fig. 58 of *Grylloblatta*, with its well developed basivalvula *bv* and valvifer *vf*, and its rather short ovipositor valves, could readily be derived from the Mantid type of ovipositor shown in Fig. 27. There is something very suggestive of the Isoptera, however (Figs. 34 and 37), in the terminal structures of the Orthoptera shown in Figs. 33 and 36, and I am inclined to think that the ancestral termites were very like the ancestors of the Orthoptera.

The ovipositor of *Grylloblatta* (Fig. 58) is closely approached by that of *Ceuthophilus* (Fig. 62) as was pointed out by Walker, 1919, in that the basivalvula *bv* and valvifer *vf* of *Ceuthophilus* (Fig. 62) are well developed, and the inner valves (not shown in Fig. 62) are not greatly reduced. In the Gryllids, on the other hand (Fig. 61), the inner valves *iv* of Fig. 75, have become greatly reduced, while the dorsal and ventral valves *dv* and *vv* are long and slender. The basal region *vb* of Fig. 61 may be referred to as the "valvibulla," and between these "valvibullæ" there extends a valvipons *vp* of Fig. 61—which may be better seen in Fig. 75 showing the posterior view of these structures. The "valvipons" *vp* of Fig. 75 bears an internal median process *evp* of Fig. 76, apparently serving for muscle attachment, as does the inner process *evf* of the valvifer shown in Fig. 76. The valvijugum *vj* of Fig. 76 extends from one ventral valve across to the other, in the region of the basivalvulæ. Walker, 1919, refers to the valvipons and valvijugum as the superior inter-

valvulæ and inferior intervalvulæ, but the designation intervalvulæ had already been applied to the intermediate valves of the ovipositor (Crampton, 1917) and there is no advantage in arbitrarily changing the application of the designation originally given to these structures. The Gryllid shown in Fig. 61 has a posteriorly projecting eighth sternite 8^s or subgenitale *sg* suggesting a relationship to the Phasmids (Figs. 59 and 52) in which the eighth sternite, or subgenitale, also projects posteriorly beneath the base of the ovipositor.

The ovipositor of the Tridactylid shown in Fig. 85 is not at all like the ovipositor of a Gryllid (Fig. 61) but it is extremely like the ovipositor of the Acridid shown in Fig. 84, and the same is true of the other terminal structures of the Tridactylids and Acridids, so that it is preferable to place the Tridactylids in the superfamily Acridoidea rather than in the superfamily Grylloidea. In the Acridid and Tridactylid shown in Figs. 84 and 85 the basivalvula *bv* is very large, and has the appearance of a basal region of a transversely divided ventral valve *vv;* the inner valves are reduced in both insects; and the short, broad, dorsal valves *dv* are similar in both. In Fig. 84, the eighth sternite 8^s projects backward over the base of the ovipositor in a manner suggestive of the Phasmid shown in Fig. 59. The ninth and tenth tergites 9^t and 10^t tend to unite ventrally, as also seems to be the case in the Gryllotalpid shown in Fig. 106. In the Acridid shown in Fig. 84 a structure which is apparently the "stalk" of a spermatophore is shown projecting from the genital orifice of the female. I found several female specimens bearing such a structure; but I have not noted any record of a spermatophore occurring in the Acrididæ, although such structures commonly occur in Gryllidæ and Tettigoniidæ, and one would expect to find them in the Acrididæ also. The eleventh tergite or suranale *sa* of the Acridid shown in Fig. 84 is transversely divided by a faint impressed line, which may possibly indicate a tendency toward a secondary division of the eleventh tergite which is carried further in Dermaptera, etc., where the supposed twelfth and thirteenth tergites may be merely the results of secondary transverse divisions of the eleventh tergite. In the Tridactylid shown in Fig. 85, there is also a marked tendency for the tergites in the

hinder region of the abdomen to split up into small plates. The Tridactylid shown in Fig. 85 has an elongated paraproct *pp* which bears a distal appendage *ps* resembling a flattened stylus *st*, which I formerly interpreted as the modified exopodite of the paraproct (the modified protopodite or coxite of the tenth segment) whose endopodite becomes the cercus *ce*. Walker, 1919, opposed this interpretation, but brought forward no evidence to refute it. The reasons for giving this interpretation to the parts are given in the Ent. News, for 1921, Vol. 32, p. 257, where a comparison of the terminal abdominal structures of insects and Crustacea is also given.

The Psocids, Mallophaga, Anoplura, Thysanoptera and Hemiptera form a group of rather closely related insects descended from Protorthopteroid ancestors in the common Protorthopteran-Protoblattid stem; and the Zoraptera, which are the most primitive representatives of the Psocids, have departed the least from the ancestral type in the general character of their terminal abdominal structures, although the Zoraptera have lost the ovipositor, which many other Psocids (Figs. 74 and 66) have retained, and in this respect the Zoraptera (Figs. 29 and 31) are more like *Embidopsocus* shown in Fig. 28. The terminal abdominal structures of the Zoraptera shown in Figs. 29 and 31, are very like the terminal abdominal structures of the Isoptera shown in Figs. 37 and 34; and the Zoraptera also resemble the Orthoptera shown in Figs. 36 and 106 much as the other Psocids (Figs. 66 and 74) resemble the Orthopteron shown in Fig. 33. These resemblances may be taken to indicate that the Psocids (including the Zoraptera) were descended from Protorthopteroid ancestors resembling the ancestral termites in many respects. In my first discussion of the relationships of the Zoraptera (Crampton, 1920) I was so deeply impressed with their resemblance to the Isoptera in the development of "rupture sulci" for casting off the wings in both groups, the occurrence of castes in both groups, the presence of a separate laterosternite in both meso- and metathorax of the Zoraptera and Isoptera alone of all insects (so far as I am aware), and the marked resemblance of the terminal abdominal structures of the Zoraptera to those of Isoptera, etc., that even with the figures of the wings of the

most closely allied Psocids and Zoraptera before me (Can. Ent. 53, p. 110), I did not realize that the Zoraptera are merely peculiar Psocids, until I had discussed their venation again (Can. Ent. 54, p. 222), thus illustrating the ''blinding'' effect of preconceived notions upon one's better judgment! A comparison of the two insects shown in Figs. 28 and 29, in which the contour of the dorso-caudal region of the abdomen is strikingly similar in both (and is unlike other insects) would bear out the conclusion that the Zoraptera are Psocids (i.e., ''Psocoptera'') based upon the study of the wings and other structures (such as the meso- and metanota, for example, in which the character of the prescutum, scutellum, etc., is like that of the Psocids and not like the Isoptera). The venation of the Zoraptera suggests that they are somewhat distantly related to the Embiids (and to the Plecoptera also), and there is a slight suggestion of relationship in the general character of the terminal abdominal structures of the Zoraptera shown in Figs. 29 and 31, and the Embiid shown in Fig. 24; but I am more inclined to regard these resemblances as due to a common heritage from Protorthopteroid ancestors which evidently resembled Isoptera in many respects.

The Mallophaga are evidently descended from Psocoid ancestors, as is clearly indicated by the peculiar character of their maxillæ (with chisel-like rods, not developed in most other insects) and other structures. The terminal structures of the Mallophagan shown in Fig. 8, however, are not strikingly like those of any Psocid I have seen, although this is evidently due to the fact that suitable material (which undoubtedly exists among some living Psocids—possibly of the *Atropos* type) is not available to me for comparison. Many recent investigators regard the Anoplura as forms closely related to the Mallophaga, and a comparison of the Anopluran shown in Fig. 10 with the Mallophagan shown in Fig. 8 would indicate that the two groups of insects are very closely related, since the general character of the terminal structures is much alike in both Anoplura and Mallophaga. Since the Mallophaga are more primitive than the Anoplura, it is very probable that the ancestors of the Anoplura were very closely allied to the Mallophaga; and if the Anoplura were not directly descended from ''Mallophagoid'' ancestors,

they were evidently descended from the Psocoid ancestors of the Mallophaga.

The Thysanoptera present some very puzzling features to the student of insect phylogeny, and the problem of determining the closest relatives of the Thysanoptera has not been solved in a wholly satisfactory manner, although many features point to a rather close relationship between the Thysanoptera and the Hemiptera; and probably the Hemiptera and Thysanoptera were derived from the same Protorthopteroid ancestors which were closely allied to the ancestors of the Psocids. The head of a Thysanopteron is vaguely suggestive of the head of an Acridid Orthopteron, and its wing-venation could readily be derived from Orthopteroid precursors, although it also approaches the Psocids in venation and is vaguely suggestive of Hymenopterous affinities in some respects (see discussion in Can. Ent., 54, p. 222, etc.). The prothoracic sclerites suggest a distant relationship to the Dermaptera, but whatever relationship the Thysanoptera have to these forms is doubtless through some Orthopteroid forebears leading back to a Protorthopteroid ancestry. The abdominal structures of the Thysanopteron shown in Fig. 64 are markedly similar to those of the Cicadid Hemipteron shown in Fig. 68, and the evidence of the terminal abdominal structures would thus be in agreement with that of the mouthparts, etc., which indicate a rather close relationship between the Thysanoptera and the Hemiptera. On the other hand, the Thysanopteron shown in Fig. 64 is very like the Hymenopteron shown in Fig. 72 (compare also Fig. 71) and this would also be in harmony with certain features of wing venation suggesting an approach to the Hymenopterous type in certain fossil Thysanoptera. Furthermore, the Thysanopteron shown in Fig. 64 resembles the Neuropteron shown in Fig. 65 quite markedly, and certain features are suggestive of those exhibited by the Psocid shown in Fig. 70. The only way in which I can account for the complicated relationships indicated by various features in the insects mentioned above, is to assume that similar Protorthopteroid ancestors in the common Protorthopteran-Protoblattid stem gave rise to the lines of descent of the Psocids, Hemiptera and Thysanoptera, and also to the lower Holometabola, of which the

Hymenoptera and Neuroptera are representatives; and whatever these different insects have in common, was possibly retained from their closely related Protorthopteroid ancestors. The Thysanoptera are quite closely related to the Hemiptera, which in turn are closely related to the Psocids, and the Psocids lead back to Protorthopteroid ancestors from which the ''Protohymenoptera'' described by Tillyard, 1926, were apparently also derived (see discussion in Bulletin Brooklyn Ent. Soc. 32, p. 1).

The Hemiptera are a very isolated group of insects whose origin and affinities are obscure. In the paper cited above (Bull. Brooklyn Ent. Soc., 32, p. 1) I have pointed out that those who insist upon attempting to derive the Hemiptera from *Eugereon* are evidently upon the wrong track, because none of *Eugereon's* structures are Hemipteroid in any way, and *Eugereon* is clearly a specialized type of Palæodictyopteron without any affinities whatsoever with the ancestors of the Hemiptera, (which were evidently derived from ancestors capable of laying the wings back along the abdomen, as the Protorthoptera, etc., can do, while *Eugereon* is evidently of the Palæodictyopteroid type, incapable of laying the wings back along the abdomen). The oldest known remains of fossil Hemiptera clearly approach the fossil Psocids in their venation; and, as was shown in Psyche, 1922, Vol. 29, p. 23, the venation of modern Psocids parallels that of recent Hemiptera marvelously closely from the most primitive to the most specialized types in both orders, thus indicating the operation of the same developmental tendencies in both, inherited from a common ancestry. This common ancestry of the Hemiptera and Psocids was evidently Protorthopteroid, and from such a Protorthopteroid ancestry in the common Protorthopteran-Protoblattid stem were derived the Protohymenoptera—which accounts for the marked resemblance between the Hymenoptera and Hemiptera. The terminal abdominal structures of the Hemipteron shown in Fig. 68 are extremely like those of the Hymenopteron shown in Fig. 71 (compare also Fig. 72) in the great development of the ninth tergite 9^t and the peculiar transverse ''break'' in the dorsal valve of the ovipositor *dv* (dividing it into a basal portion *pv* and a distal portion *ds*) which behaves in this fashion only in the Hemiptera and Hymenoptera (so far as I

am aware). The Hemipteron shown in Fig. 68 is also very like the Neuropteron shown in Fig. 65 in the development of the ninth tergite 9^t and the distinct tenth segment which is not completely fused with the ninth in these insects, as is the case in many other forms. This resemblance to the Neuroptera on the part of the Hemiptera is borne out by a comparison of the thoracic sclerites in the two groups, and evidently the Protorthopteroid ancestors of the Psocids and Hemiptera in the common Protorthopteran-Protoblattid stem gave rise to the ancestors of the Holometabola also (among these being the Neuroptera and Hymenoptera). The terminal abdominal structures of most Hemiptera are not as much like those of typical Psocids as one would expect them to be from the many resemblances between the Psocids and Hemiptera in other features of the body (and the wing-venation in particular); but the peculiar lateral process *lp* of the Hemipteron shown in Fig. 67 is very similar to the peculiar lateral process *lp* of the Psocid shown in Fig. 66, which is interpreted by some entomologists as the modified dorsal valve of the ovipositor.[3] Whatever the homologies of this peculiar lateral process may be (i.e., *lp* of Figs. 66 and 67) it seems to be developed only in the Psocids and Hemiptera (but compare Fig. 92) and its presence in this form in the two groups indicates a close relationship between them, as is also indicated by many other structures as well. The occurrence of what appear to be styli-bearing coxites in such Hemiptera as the one shown in Fig. 39 (i.e., the structures labelled *cx* and *st*) would indicate that the Hemiptera arose from ancestors in the common Protorthopteran-Protoblattid stem closely resembling the ancestors of the insects shown in Figs. 38, 41, 45 and 49, if I have interpreted aright the structures labelled *cx* and *st* in Fig. 39. I have interpreted the small structures labelled *ce* in Fig. 68 as cerci, although it is not clear what their actual homologies are, and if they represent cerci, these structures are a very primitive feature not present in any other Hemiptera of which I have any knowledge.

[3] The process *lp* of Figs. 67, 66 and 74 may represent the lobe-like process *lp* of Fig. 92, or some similar outgrowth, instead of the modified dorsal valve of the ovipositor.

Most Hymenoptera have distinct cerci *ce,* which in some sawflies, such as the one shown in Fig. 77, may be very long and well developed. I likewise noted what appeared to be distinct segments in the long cerci of a small dark sawfly captured by Dr. C. P. Alexander in sweeping skunk-cabbage plants in the neighborhood of Amherst (Mass.); but I have mislaid the specimen which Dr. Alexander gave me, and am therefore unable to figure its cerci at this time. The occurrence of long Orthopteroid cerci in sawflies (Fig. 77) suggests a Protorthopteroid ancestry for the Hymenoptera (and the Protohymenoptera also) as likewise does the fact that most Hymenoptera have retained all three valves of the ovipositor; and the primitive sawfly shown in Fig. 92 has even retained what appears to be a vestigial stylus *st* at the end of the dorsal valve *dv.* If this small structure is really a vestigial stylus, as it appears to be, it is very probable that the ancestors of the Hymenoptera had ovipositors like those of the insects shown in Figs. 38, 41, 45 and 49.

Since various structural details of the head (e.g., the clypeus, ocelli, etc.) and of the thorax (e.g., the prescutum, scutellum, etc.) as well as the wing venation (Canadian Entomologist, 1922, Vol. 54, p. 222) indicate that the Hymenoptera had a common ancestry with the Psocids, and the wings of the Protohymenoptera are very like those of fossil Psocids (Bull. Brooklyn Ent. Soc., 1927, Vol. 22, p. 1), one would naturally expect to find a marked similarity in the terminal abdominal structures of the Hymenoptera and the Psocids, and one would expect that the terminal structures of the Hymenoptera would resemble those of Isoptera as much as the Psocids do. The terminal abdominal structures of the Hymenoptera, however, are much more like those of the Hemiptera (compare Figs. 72 and 71 with Fig. 68), as was mentioned above, so that the Hymenoptera are apparently much more closely related to the common ancestors of the Hemiptera and the Psocids, than they are to the Psocids themselves.

The Hymenoptera and Coleoptera occupy a somewhat isolated position within the Holometabola; and both are quite primitive representatives of the group. In some respects the Hymenoptera resemble the Coleoptera more closely than they do the Neuroptera (and Mecoptera), namely in the absence of a meron in the middle

coxæ of Hymenoptera and Coleoptera (but present in the Neuroptera and Mecoptera) and in the closer approach of the Protohymenopterous venation to the Coleopterous type than to the Neuropterous (and Mecopterous) type, etc. The larvæ of Hymenoptera, however, are much more like those of the Mecoptera; and many features of the adult anatomy (such as the presence of three ocelli, the character of the prescutum, scutellum, etc., and the nature of the genitalia of the male, together with the development of the cerci, etc.) point to a closer relationship between the Hymenoptera and the Mecopteroid forms (i.e., Neuroptera, Mecoptera, etc.). The terminal abdominal structures of the Hymenoptera (Fig. 69) are very similar to those of certain "Mecopteroid" or Neuropterous forms, such as the Neuropteron shown in Fig. 65 (compare also Figs. 91 and 92) in the development of the ninth tergite, and its relation to the tenth segment, and in the development of the ovipositor which is long and slender in the Hymenoptera and Neuroptera shown in Figs. 69 and 65, while these features of the Hymenoptera are not very like the parts of any Coleopteron I have seen. This doubtless indicates that the Hymenoptera are more closely related to the common ancestors of the Coleoptera and Neuroptera than they are to the Coleoptera and Neuroptera themselves.

I am hoping to make a comparative study of the ovipositor throughout the Hymenoptera, in order to clear up certain points which should be re-examined from the standpoint of comparative morphology if the modifications of the parts in the higher Hymenoptera are to be properly understood, and at this time I would merely refer very briefly to some of the features of sawfly anatomy which seem to be of importance for understanding the modifications of the higher forms. The dorsal valve *dv* of the ovipositors of the sawflies shown in Figs. 71 and 72 is divided by a transverse "break" or weakening of the integument, into a proximal region *pv*[4] and a distal region *ds* (compare also the dorsal valve of the Hemipteron shown in Fig. 68). In the

[4] In the Orthoptera figured in Figs. 84 and 85, it is very probable that the basal regions of the dorsal valves labelled *bv* represent the proximal regions of the dorsal valves labelled *pv* in Figs. 68, 71 and 72. I have therefore added the labels *pv* and *ds* in Figs. 84 and 85, to indicate this fact.

Ichneumonid shown in Fig. 73, the proximal region *pv* of the dorsal valve *dv* becomes closely applied to the parts above it, and a further weakening of the chitinous integument separates it rather sharply from the distal portion *ds* of the dorsal valve which projects posteriorly to form a palpus-like structure like the "sting-palp" of bees, etc., in which the basal portion of the dorsal valve is apparently interpreted as representing the ninth sternite, while the distal portion alone of the dorsal valve is interpreted as representing the entire dorsal valve in the bees, etc. The sclerite *vf* of Figs. 69, 71 and 72, has been provisionally interpreted as the valvifer rather than the basivalvula, although it has much the same appearance as the basivalvula *bv* of the Hemipteron shown in Fig. 68.

The Coleoptera occupy a rather isolated position within the Holometabola, and in some respects they are the lowest representatives of the group, although in the specialization of their wings, they have gone beyond the Neuroptera, Mecoptera, etc. Their general make-up strongly suggests a Protorthopteroid ancestry in forms closely allied to the Protorthopteroid ancestors of the Dermaptera, in the common Protorthopteran-Protoblattid stem. Forbes, 1928, with some jusice, assigns Tillyard's *Protocoleus* (considered by Tillyard as representing the Protocoleopterous ancestor of the Coleoptera) to the Orthoptera, although I am more inclined to regard *Protocoleus* as a Protorthopteron exhibiting adumbrations of features later appearing in the Coleopterous descendants of Protorthopteroid forebears. The venation of primitive Coleoptera described by Forbes, 1922, is very suggestive of the Sialid Neuroptera, and is approached by the venation of the Protohymenoptera in certain respects. The head region of adult Coleoptera such as the Lampyrids, is very like that of the Sialid Neuroptera, and the same is true of the mouthparts of larval Coleoptera and Neuroptera. The thoracic sclerites of larval Coleoptera are more like those of larval Neuroptera than any other forms, but I find a greater resemblance to the Hymenoptera in the pleural thoracic sclerites of adult Coleoptera, and the middle coxæ of Coleoptera and Hymenoptera have not a meron characteristic of Neuroptera and their relatives. We may therefore conclude that the Coleoptera

are not extremely closely related either to the Neuroptera or to the Hymenoptera, but the Coleoptera doubtless represent an early offshoot from the Protorthopteriod ancestors of the Holometabola.

The presence of styli-bearing coxites *cx* and *st* in the primitive Coleoptera shown in Figs. 46 and 42, would indicate that the Coleoptera were derived from forebears having ovipositors like those shown in Figs. 50, 38, 41, 45 and 49, the character of the styli-bearing coxites of the Coleoptera shown in Fig. 42 being very like those of the Blattid shown in Fig. 45, while those of the Coleopteron shown in Fig. 46 are longer and slenderer, like those of the Orthopteron shown in Fig. 50. From the primitive character of the coxites *cx* and styli *st* (which occur very rarely in adult Pterygotan insects) of the Coleopteron shown in Fig. 42, one might be led to think their ancestors were more Protoblattoid than Protorthopteroid and in any case, I think it very probable that the ancestors of the Coleoptera, and hence of all the other Holometabola as well, were forms in the common Protorthopteran-Protoblattid stem partaking of the characters of both Protoblattids and Protorthoptera, rather than of the Protorthoptera alone.

The terminal abdominal structures of Coleoptera are developed along their own peculiar lines of specialization; and it is very difficult to determine the homologies of the various parts in the higher forms, although Tanner, 1927, has given an excellent discussion of the parts in most of the important families of the order Coleoptera. There are many points which are not definitely determined despite Tanner's fine work, and it seems to me that in some cases the region which he interprets as the valvifer may be a detached portion of the coxite, while the structure which he calls the paraproct is probably the surstylus or lateral portion of the ninth tergite, since the paraprocts are structures borne on the posterior region of the tenth segment while the structures he interprets as the paraprocts (i.e., *ss* of Fig. 83) are evidently borne on the ninth segment, and should therefore represent surstyli. Tanner refers to the rod-like thickenings of the integument, labelled *b* in Fig. 88, as the baculi, in Coleoptera. They resemble the urolora *l* of the Trichoptera

and Lepidoptera shown in Figs. 86, 79 and 78; but in the latter insects the lora-like thickenings extend to the cerci instead of extending to the coxites as is the case with the baculi of the Coleoptera. The terminal structures of the Coleoptera are not very similar to those of the Neroptera or Hymenoptera, and the marked difference between the terminal structures of Coleoptera and the other forms emphasizes the isolated position of the Coleoptera within the Holometabola.

In their wing venation, the Neuroptera are among the most primitive representatives of the Holometabola, and the head region is also quite primitive in the Sialid Neuroptera, so that one would expect that the terminal abdominal structures of these insects would also be fairly primitive, but all of the forms I have seen are are very disappointing in this respect; and they offer only the slightest clews as to the affinities of the Neuroptera. The terminal structures of the Neuropteron shown in Fig. 65 are extremely like those of the Hymenopteron shown in Fig. 69, and indicate a rather close relationship between the two groups of insects. In the development of the ninth tergite, and in retaining a distinct tenth segment not fused with the ninth, the Neuropteron shown in Fig. 65 resembles the Hemipteron shown in Fig. 68, and is approached by the Thysanopteron shown in Fig. 64. In the division of the mesothoracic episternum into an ana- and kata-episternum, in the retention of a meron, etc., the Hemiptera likewise resembles the Neuroptera very markedly; and it is very probable that these resemblances are due to the fact that the Hemiptera (with the Psocids) arose from the same type of Prothorthopteroid ancestors which gave rise to the ancestral Holometabola (with the Neuroptera retaining many primitive features within the group). Strangely enough, the Neuroptera tend to lose the cerci, unless the structure labelled *ce* in the Neuropteron shown in Fig. 91 is a cercus; and the styli are apparently absent in all Neuroptera of which I have any knowledge, although the small structure labelled *st* in Fig. 82 may possibly represent a vestigial stylus. The terminal abdominal structures of the Sialids shown in Figs. 82 and 91 are not as similar to those of the Raphidian shown in Fig. 65, as one would expect them to be; and while the Sialid shown in

Fig. 91 is somewhat suggestive of the Mecopteron shown in Fig. 87, the similarity is not very great, and the terminal abdominal structures of the Neuroptera are not as useful for indicating the affinities of the group as they are in the Holometabola next to be considered.

The Mecoptera are evidently descended from Neuropteroid ancestors and they, in turn, are very like the ancestors of the Diptera, and of the Trichoptera and Lepidoptera also, as is indicated by the wings of the fossil Protomecoptera, Prototrichoptera (*Belmontia*) and Protodiptera (*Aristopsyche*) described by Tillyard. Adumbrations of the type of mouthparts later developed in the Mecoptera are exhibited by Neuroptera such as the Nemopteridæ, and the precursors of the types of cervical sclerites, pronotum, prothoracic pleural and sternal plates, etc., exhibited by the Mecoptera, are to be found among the Neuroptera and Hymenoptera (sawflies), while the male genitalia of Mecoptera are "built" on the Hymenopteroid plan (sawflies) and the larvæ of Hymenoptera are very like those of the Mecoptera, so that the Mecoptera were evidently descended from the common stock which gave rise to the lines of descent of the Hymenoptera and Neuroptera rather than from the Neuroptera themselves. The terminal abdominal structures of a typical Mecopteron (Fig. 107) are not very similar to those of the primitive Neuroptera shown in Figs. 91 and 82, and the Mecoptera have preserved the cerci *ce* (of Fig. 107) in a more primitive condition than the Neuropteron shown in Fig. 91 has, although the terminal structures of the Neuropteron shown in Fig. 91 are evidently specialized from a type more like that exhibited by the Hymenopteron shown in Fig. 92, and hence had a lower origin than did the parts in the Mecoptera (the Neuropteron shown in Fig. 65 is also more like the Hymenopteron shown in Fig. 69, and is therefore more primitive than the Mecopteron shown in Fig. 107). The terminal structures of the Mecopteron shown in Fig. 87 are somewhat suggestive of those of the Neuropteron shown in Fig. 91 but the resemblance is not as great as one would expect to find, judging from the great similarity of the wings of the Protomecoptera to those of the Sialid Neuroptera. It is evident that the Mecoptera are more like the

Hymenoptera in tending to retain the cerci, while the Neuroptera are more like the Hymenoptera in retaining the ovipositor quite well developed in the Raphididæ (with traces of it in other Neuroptera) and the different ways of retaining similar features in some parts and not in others in all three groups show that they came from a common ancestry rather than that any one of the groups is ancestral to the others.

The Diptera are the closest relatives of the Mecoptera, and the Diptera were undoubtedly descended from Mecopteroid forebears, if not from the Mecoptera themselves, as is attested by a multitude of structures from all parts of the body. The head contour (Crampton, 1917), the structural details of the maxillæ (Crampton, 1923), the parts of the labium (Crampton, 1925), the sclerites of the neck and prothorax (Crampton, 1926), and the sclerites of the mesonota (Crampton, 1919), and the structure of the male genitalia (Crampton, 1923) are so astonishingly similar down to the minutest details in the two groups, that there can not be the slightest doubt of the extremely close relationship of the Diptera to the Mecoptera (a relationship that is far closer than that of the Mecoptera to the Neuroptera, for example); and the terminal abdominal structures of the female insects amply confirm the evidences of relationship furnished by other parts of the body.

It is not always the most *primitive* features exhibited by two groups of insects which best indicate the close relationship of these two groups of insects, since peculiar modificational tendencies or *specializations* occurring only in the groups in question (but not necessarily in all of the members of the two groups) will frequently be of more value as indices of relationship than the primitive features are—provided that one is careful to avoid all chance of being deceived by convergent development. Such a case of similarity in structural modifications is well illustrated by the Mecopteron shown in Fig. 103 and the Dipteron shown in Fig. 104. Thus the strange modification of the cercus *ce* the Mecopteron shown in Fig. 103, in which the cercus tends to become rather plate-like, with a peculiar longitudinal line running down its lateral surface, is clearly an adumbration of (or is prophetic of) the modification

of the cercus *ce* of the Dipteron shown in Fig. 104, in which the same thing happens; and these insects are the only types exhibiting a tendency toward such modifications (so far as I am aware). Similarly, the proportions of the ninth and tenth tergites (or of the subdivisions of the ninth, if the tergites labelled ninth and tenth tergites are merely parts of a secondarily divided ninth tergite) are strikingly alike in both insects; and in both, the eighth sternite projects backward behind the ninth segment in a similar fashion. When one realizes that the two insects belong to separate *orders* (Mecoptera and Diptera) the detailed resemblance is all the more marvellous. It is true that the Dipteron shown in Fig. 104 has secondarily developed a pair of valve-like processes of the eighth sternite *sv*, which are not present in the Mecopteron shown in Fig. 103; and the Dipteron shown in Fig. 104 exhibits a medigynium *mg* not found in the Mecopteron shown in Figs. 103, but another Mecopteron, such as the one shown in Fig. 107 exhibits a medigynium *mg*, so that the presence or absence of such a structure is a matter of no phylogenetic significance in this instance (and of course many Diptera related to the one shown in Fig. 104 have no valves like those labelled *sv* in Fig. 104, thus showing that the presence of such valves, or their absence, is of no importance for indicating the affinities of the forms in question).

According to the "adumbration" theory, a modificational tendency (e.g., the peculiar modification of the cercus described above) may occur in some members of an "ancestral" or more primitive group (e.g., the Mecoptera) and again re-appear in some members of a "derived" or more specialized group (e.g., the Diptera) despite the fact that all (or even most) of the members of both groups may not give any indication of the presence of such a tendency in their structural modifications, due to the fact that the tendency in question (or its genes) may be "latent" in them and will manifest itself only upon the proper combination of genes, or what not, which will enable it to make itself "patent." In such cases, similar results produced by similar tendencies are not the result of "convergent" development, but are the result of the operation of similar genes inherited from a common ancestry. The operation of such ten-

dencies which may even pass from one closely related order to another order derived from it (or in an extreme case may pass from the transitional forms belonging to one class, such as the Crustacea, to the lower members of a derived class such as the insects or ''myriopods'') is very evident to one whose studies lead him to consider wide ranges of forms; but entomologists in general do not take kindly to this idea, and the time is apparently not ripe for its development.

The valve-like processes *sv* of the eighth sternite of the Dipteron shown in Fig. 104 are apparently homologous with the valve-like precesses *sv* of the eighth sternite of the primitive Dipteron shown in Fig. 102, and I formerly interpreted these structures *sv* in *Macrochile* (Fig. 102) as the modified ventral valves of the ovipositor which had united with the eighth sternite; but I am more inclined to consider that the valve-like process in both insects (Figs. 104 and 102) are merely secondary outgrowths of the eighth sternite—although I would not insist upon this interpretation of them. The medigynium *mg* of Figs. 102, 104 and 107 probably represents an outgrowth of the ninth sternite instead of representing the united dorsal valves of an ovipositor, since a true ovipositor is apparently not developed in the Mecoptera and Diptera, its place being taken by various secondarily formed structures.

Some Diptera, such as the ones shown in Figs. 101, 97 and 94, have two-segmented cerci *ce* (composed of a basal segment, or basicercus *bc,* and a disticercus *dc*) like those of the Mecoptera shown in Fig. 107. I formerly suggested that the basal segment *bc* of the cerci of the Diptera (Figs. 94 and 98) might represent a paraproct, because the basal segment of the cerci of the Diptera in question is very broad and the distal segment has the appearance of a cercus borne at the end of a paraproct; but it is preferable to interpret the structure *bc* as the basal segment of the cercus in the Diptera shown in Figs. 94 and 96, since in other Diptera, such as the one shown in Fig. 101, the basal segment evidently is of the same nature as the distal segment of the cercus, and in the more primitive relatives of the Diptera, such as the Mecopteron shown in Fig. 107, the cerci are evidently two-segmented, and the inference naturally is, that the cerci of the

Diptera derived from Mecopteroid forebears would also be two-segmented, instead of the basal segment of the cerci of Diptera representing a retention of a paraproct, no signs of which appear in their primitive relatives, the Mecoptera.

The venation of the fossil Protodipteron *Aristopsyche* described by Tillyard, is clearly annectant between the Diptera and certain Mecopterous types, and its venation is so much like that of certain Mecoptera (e.g., the hind wing of *Panorpodes*) that I formerly maintained that *Aristopsyche* is in reality a Mecopteron (a view which Tillyard is inclined to favor in his later discussions of this insect) ; but the venation of *Aristopsyche* is so like that which must have been exhibited by the ancestors of the Diptera, that we are justified in regarding it as a Protodipteron, even if it should prove to be merely of subordinal rank among the Mecoptera, since the Diptera were evidently descended from forms which would have been classed as Mecoptera, if they were not Protodiptera. The Trichoptera approach the Diptera in some respects, and the terminal adbominal structures of the Trichopteron shown in Fig. 99 are very similar to those of the Dipteron shown in Fig. 97; but it is quite possible that the resemblances between the Diptera and Trichoptera are due to their mutual relationship to the Mecoptera, which are very like the common ancestors of both.

Tillyard has described the wing of a fossil Prototrichopteron *Belmontia*, which is very like the common ancestors of the Trichoptera and Lepidoptera and leads back to the Protomecopteran types merging with the primitive Neuroptera. The wings of the Trichoptera and Micropterygid Lepidoptera are so much alike that Comstock at first placed the Micropterygids within the order Trichoptera; and I have pointed out the remarkable similarity in structure between the Micropterygid Lepidoptera and such Trichoptera as *Philopotamus* (Crampton, 1920)—a similarity which is so striking even in the minuter details, and which extends to so many different parts of the body, that we may conclude that the Lepidoptera and Trichoptera should be separated into distinct orders only for the sake of convenience. The remarkable similarity between the terminal abdominal structures of the Trichopteron shown in Fig. 78 and the Lepidopteron

shown in Fig. 79 is most remarkable, and the study of the terminal structures clearly bears out the evidence of an intimate relationship between the Trichoptera and Lepidoptera indicated by the other structures of the body in general.

In the Trichopteron shown in Fig. 86, the basicerci *bc* (or basal segments of the cerci) are distinct, and resemble the cerci *ce* of the Dipteron shown in Fig. 97, for example; but in the Trichopteron shown in Fig. 78 and in the Lepidopteron shown in Fig. 79, the basal segments of the cerci apparently unite to form a "symbasite" *bc* bearing the disticerci *dc* which give the appearance of being the entire cerci reduced to one segment. The urolora *l* are very similar in both insects shown in Figs. 78 and 79 and are doubtless homologous in the two groups of insects; but the urolora *l* of Figs. 78 and 79 are apparently not strictly homologous with the bacculi *b* of the Coleopteron shown in Fig. 88, and the cerci *ce* of Figs. 78, 79 and 86 should not be confused with the coxites *cx* and styli *st* of Fig. 88, although these structures are superficially very similar.

The Siphonaptera are perhaps the most baffling of all insects to the student of phylogeny, since most of the structures of the Siphonaptera offer no serviceable clues as to the closest affinities of the Siphonaptera although their development clearly indicates that they are Holometabola, and offers some suggestion of a relationship to the Diptera; and most entomologists agree in placing them next to the Diptera. Martini, however, has recently revived the old idea that the Siphonaptera are descended from the Coleoptera, basing his conclusions upon the internal structures, but the question is by no means settled yet, and these puzzling insects are still somewhat of an enigma to the student of insect phylogeny.

I have pointed out that the Siphonaptera cannot be descended from the Diptera because the labial palpi of the Siphonapter are frequently composed of three segments, while the labial palpi of the Diptera (which are modified to form the labella) are composed of only two segments, as is also the case in the labial palpi of the Mecoptera as well, and the Siphonaptera cannot be descended from forms less primitive than they in this respect. Furthermore, the metathorax is always reduced to an exceedingly

small area in the Diptera (in both winged and wingless forms) while in the fleas the metathorax is about as well developed as the mesothorax, and the fleas are therefore more primitive in this respect also than the Diptera are, and therefore cannot be derived from the Diptera. The metathoracic coxæ are divided into a eucoxa and meron in the fleas, while such a primitive condition is not preserved in any Dipteron, and these and many other features would preclude our deriving the Siphonaptera from forms as specialized as the Diptera are. On the other hand, in the features mentioned above, the Trichoptera are more primitive than the Siphonaptera, (as is true of their structures in general) and I find much that is suggestive of Trichopterous affinities in the anatomy of fleas—such as the character of the metathoracic coxa (which is divided into a eucoxa and meron in both insects), the nature of the prothoracic sclerites (see Crampton, 1926), etc.—and the view that the fleas were descended from Trichopteroid ancestors is as probable as any.

The Siphonaptera were evidently descended from forms having both meso- and meta-thoracic coxæ divided into eucoxa and meron (as in the Trichoptera) since this condition is exhibited by both meso- and meta-thoracic coxæ in all Siphonaptera of which I have any knowledge, while no Coleoptera exhibit the slightest tendency for the mesothoracic coxæ to become so divided (in any of the Coleoptera I have examined). While the terminal abdominal structures do not offer any valuable clues as to the affinities of the fleas, as I had hoped they might, these structures in the Siphonaptera might be derived from either Trichopterous or Dipterous forebears, but not from Coleopterous precursors, if the structures labelled *ce* in Fig. 7 of the dog-flea are correctly homologized, since the Coleoptera show no signs of preserving the cerci, while the dog-flea (and other Siphonaptera) has preserved the cerci *ce* of Fig. 7, and must therefore be descended from cerci-bearing ancestors, which were apparently like the Trichoptera in most respects.

The Strepsiptera should have been considered just after the Coleoptera, since the larvæ of the Strepsiptera indicate that the group was derived from Coleopterous forebears, and the females of certain Rhipiphorid beetles are modified in a manner sug-

gestive of the ancestors of the Strepsiptera. Recently, winged females of the Strepsiptera have been found (so I have been told), but until these interesting forms have been described, we have only the highly modified types of females for studying the terminal structures of the females of the group, and these are too highly modified to offer any worthwhile cleus as to the affinities of the Strepsiptera. The character of the larvæ, however, indicates that the Strepsiptera are a rather specialized offshoot of the Coleoptera, and most investigators are now agreed in assigning this position to the Strepsiptera in the general classificational scheme.

The relationships and phylogenetic grouping of the orders of living insects are indicated in the following table, from which the fossil orders have been omitted for the sake of brevity. The relationships of the fossil orders to their living descendants, however, have been indicated in a table published in the Entomologist, Vol. 61, Apr., 1928, p. 82. The abbreviated table is as follows:

APTERGOTA

Entotrophica

Panprotura

1. Order Protura

Pancinura

2. Order Eucinura or Collembola

Pandicellura

3. Order Dicellura (Japyx and Campodea)

Ectotrophica

Panthysanura

4. Order Protothysanura (Machilis)
5. Order Thysanura (Lepisma)

PTERYGOTA

Archipterygota

Panephemeroptera

6. Order Ephemeroptera (Ephemera)

Panæshnoptera

7. Order Aeshnoptera or Odonata

Neopterygota

Panisoptera

8. Order Dictyoptera (Blatta and Mantis)
9. Order Isoptera (Termes)
10. Order Dermaptera?

Panorthoptera

11. Order Orthoptera (Grylloblatt & Saltatoria)
12. Order Phasmoptera (Phasma)

? Order Dermaptera?

Panplecoptera

13. Order Embioptera (Embia)
14. Order Plecoptera (Perla)

Panpsocoptera

15. Order Psocoptera (Psocus)
16. Order Nirmaptera or Mallophaga
17. Order Pediculaptera or Anoplura

Panthysanoptera

18. Order Thysanoptera (Thrips)

Panhemiptera

19. Order Hemiptera (Homoptera and Heteroptera)

Pancoleoptera

20. Order Coleoptera
21. Order Strepsiptera (Stylops)

Panhymenoptera

22. Order Hymenoptera

Panmecoptera

23. Order Neuroptera
24. Order Mecoptera (Panorpa)
25. Order Diptera
26. Order Trichoptera
27. Order Lepidoptera

Pansiphonaptera

28. Order Siphonaptera (Pulex)

The tenth order, Dermaptera, has been placed in the superorder Panisoptera merely to suggest that according to the structures here studied (the parts in the region of the ovipositor) there may be some grounds for grouping the Dermaptera with the roaches and termites. On the other hand, there are many

features which indicate that the Dermaptera are more closely related to the Orthoptera and Phasmids in the superorder Panorthoptera, and it is therefore more logical to place the Dermaptera in the latter superorder.

As was suggested in the article in Vol. 61 of the Entomologist, the Mecopteroid insects (orders 20 to 28 inclusive) constitute the Holometabola; the Hemipteroid insects (orders 15 to 19 inclusive) constitute the Parametabola; the Orthopteroid insects (orders 8 to 14 inclusive) constitute the Paurometabola; and the Ephemeroid insects (orders 6 and 7) constitute the Hemimetabola. The Entotrophica have been called the Protometabola, and the Ectotrophica have been called the Archimetabola.

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ABBREVIATIONS

The designations 8^s, 9^s and 10^s refer to the sternites of the eighth, ninth and tenth segments, respectively. The designations 8^t, 9^t and 10^t indicate the tergites of these segments.

b. Bacculi.
bc. Basicercus (and symbasite) or basal segment of cercus.
bcx. Basicoxite (Basivalvula?).
bv. Basivalvula, or modified coxite of the eighth segment.
ce. Cercus.
cf. Cercifer.
cg. Cerciger (Precercus).
cx. Coxite (modified protopodite) or dorsal valve of ovipositor.
dc. Disticercus or distal segment of cercus.
ds. Distivalvula or distal portion of dorsal valve.
dv. Dorsovalvula or dorsal, i.e. posterior, valve of ovipositor (modified coxite).
en. Endopodite.
ep. Epiproct or tenth tergite.
evf. Endovalvifer.
evp. Endovalvipons.
ex. Exopodite.
hg. Hypogynium or seventh sternite.
hv. Hypovalvae or hypogynial valves of the seventh sternite.
iv. Intervalvulae or intermediate valves of ovipositor (modified endopodites).
l. Urolora or slender lora-like structures of abdominal region.
lp. Lateral process regarded as modified dorsal valve of ovipositor by some.
mg. Medigynium or median structure resembling dorsal valves of ovipositor in position.
o. Ovipositor of Protura.
pg. Proctiger.
pp. Paraproct (modified protopodite or coxite, possibly of tenth segment).
pr. Protopodite.
ps. Pseudostyle, parastyle or paraprocessus.

ti. Telofilum or telappendix (telite)
pv. Proximovalvula, or proximal portion of dorsal valve.
pfv. Paravalvifer.
s. Spermatophore?
sa. Suranale or eleventh tergite.
sg. Subgenitale or eighth sternite.
ss. Surstyli or surgonopods.
st. Gynostyle in female insects, stylus in Thysanura (modified exopodite).
stg. Subtergite.
sv. Subvalvae.
ti. Telofilum or telappendix (telite) a portion of the telson.
v. Valvilora.
vb. Valvibulla.
vf. Valvifer or modified portion of ninth sternite.
vj. Valvijugum.
vp. Valvipons.
vv. Ventrovalvulae or anterior valves or ovipositor (modified endopodites).

EXPLANATION OF PLATES IX–XVI

Unless otherwise stated, the following figures portray lateral views of the terminal abdominal structures and external genitalia of female insects, in which the anterior region is directed toward the left hand margin of the plate. In the dorsal or ventral views (which are specified as such) the posterior region is usually directed toward the upper margin of the plate.

Figure 1. Hypothetical Crustaceoid ancestor of insects.
Figure 2. Diagrammatical figure of typical Machiloid insect (Compare also Fig. 6).
Figure 3. Diagrammatic figure of typical Odonatan (Compare Fig. 9).
Figure 4. Diagrammatic figure of typical Orthopteroid insect (Compare also Figs. 58 and 85).
Figure 5. Naiad (immature form) of the Plecopteran *Perla* sp.
Figure 6. A Protothysanuran Apterygotan insect *Machilis* sp.
Figure 7. The dog-flea (Siphonapteran).
Figure 8. Ventral view of the Mallophagan *Gonioides cervicornis.*
Figure 9. The Odonatan *Agrion maculatum.*
Figure 10. Ventral view of the body louse (Anopluran).
Figure 11. The Proturan *Eosentomum germanicum* (Based on figures by Prell).
Figure 12. A typical Ephemerid.
Figure 13. The Thysanuran *Atelura kohli* (After Escherich).
Figure 14. A Dicelluran *Heterojapyx* sp.
Figure 15. Ventral view of Collembolan *Lipura ambulans* (After Nassonow).
Figure 16. Coleopteran larva *Gallerita janus.*
Figure 17. A Thysanuran *Assmuthia spinosissima* (After Enderlein).
Figure 18. A Dicelluran *Campodea* sp.
Figure 19. A Plecopteran *Capnia* sp.
Figure 20. An Ephemerid *Leptophlebia betteni* (After Morrison).
Figure 21. A Plecopteran *Eusthenia spectabilis.*
Figure 22. A Collembolan *Tomocerus flavescens* (After Folsom).

Figure 23. Dorsal view of the Dicelluran *Anajapyx vesiculosus* (After Silvestri).
Figure 24. The Embiid *Embia major.*
Figure 25. Cercus of a Plecopteran.
Figure 26. A typical Ephemerid.
Figure 27. A Mantid *Stagmomantis.*
Figure 28. A Psocid *Embidopsocus* sp.
Figure 29. A Psocid *Zorotypus snyderi.*
Figure 30. A termite *Archotermopsis wroughtoni.*
Figure 31. A Psocid *Zorotypus hubbardi.*
Figure 32. A termite *Mastotermes darwini.*
Figure 33. An Orthopteran *Stenopelmatus* sp.
Figure 34. A typical termite.
Figure 35. A roach *Periplaneta americana.*
Figure 36. A mole cricket *Gryllotalpa.*
Figure 37. A termite *Termes bellicosus,* male.
Figure 38. Ventral view of an immature Orthopteron *Tettigonia albifrons* (After Chopard).
Figure 39. Ventral view of a Hemipteron *Corixa* sp.
Figure 40. A Chilean Plecopteron.
Figure 41. Ventral view of an immature *Mantis religiosa* (After Chopard).
Figure 42. Ventral view of a Salvadorean Lampyrid.
Figure 43. An embryonic *Mantis religiosa* (After Heymons).
Figure 44. An immature Plecopteron *Pteronarcys* sp.
Figure 45. Ventral view of an immature roach.
Figure 46. Ventral view of a Lampyrid.
Figure 47. An embryo of the Chinese mantis.
Figure 48. An embryo of *Mantis religiosa* (After Heymons).
Figure 49. Ventral view of a soldier of the termite *Mastotermes darwinensis.*
Figure 50. Ventral view of an immature Orthopteron *Grylloblatta campodeiformis.*
Figure 51. Ventral view of ovipositor of Proturan *Acerentomon doderoi,* (After Berlese).
Figure 52. A typical Phasmid.
Figure 53. Last segment and cercus of *Grylloblatta.*
Figure 54. A Dermapteron *Hemimerus talpoides.*
Figure 55. A Dermapteron *Echinosoma occidentale.*
Figure 56. A Dermapteron *Apachys* sp.
Figure 57. Last segment and cercus of Dermapteron *Arixenia* (male).
Figure 58. An Orthopteron *Grylloblatta campodeiformis.*
Figure 59. A Phasmid *Timema californica.*
Figure 60. Cercus of an immature Dermapteron *Diplatys.*
Figure 61. An Orthopteron *Gryllus* sp.
Figure 62. An Orthopteron *Ceuthophilus gracilipes.*
Figure 63. Ventral view of a Phasmid *Phyllium.*

Figure 64. A Thysanopteron *Orothrips* sp.
Figure 65. A Neuropteron *Raphidia notata.*
Figure 66. A typical Psocid.
Figure 67. A Fulgorid Homopteron.
Figure 68. A Cicada *Cryptotympana epithesia.*
Figure 69. A sawfly *Xyela* sp.
Figure 70. A Psocid.
Figure 71. A Siricid sawfly.
Figure 72. A sawfly *Macroxylea ferruginea.*
Figure 73. An Ichneumon *Ophion* sp.
Figure 74. A typical Psocid.
Figure 75. Posterior view of end of abdomen and ovipositor of *Gryllus* sp.
Figure 76. Interior view of same.
Figure 77. A sawfly.
Figure 78. A Trichopteron.
Figure 79. A clothes moth.
Figure 80. A Dytiscid beetle.
Figure 81. A larval Trichopteron *Rhyacophila.*
Figure 82. A Neuropteron *Sialis* sp.
Figure 83. A Staphylinid beetle.
Figure 84. A grasshopper related to *Dissosteria.*
Figure 85. An Orthopteron *Rhipipteryx atra.*
Figure 86. A typical Trichopteron.
Figure 87. A Mecopteron *Bittacus* sp.
Figure 88. A Malachiid beetle.
Figure 89. A Plecopteron related to *Pteronarcys.*
Figure 90. A Silphid beetle *Necrophilus* sp.
Figure 91. A Neuropteron *Corydalis cornuta.*
Figure 92. A sawfly *Lyda* sp.
Figure 93. Dorsal view of a Strepsipteron *Dacyrtocara undata* (After Pierce).
Figure 94. A Leptid Dipteron related to *Chrysopilus.*
Figure 95. Ventral view of a beetle *Platypsyllus castoris.*
Figure 96. Dorsal view of a fossil Tanyderid Dipteron *Macrochile spectrum* (Baltic amber).
Figure 97. A Dipteron *Sciara sciophila.*
Figure 98. Lateral view of *Macrochile.*
Figure 99. A Trichopteron *Philopotamus.**
Figure 100. A Neuropteron *Climacea.*
Figure 101. An Asilid Dipteron.
Figure 102. Ventral view of *Macrochile.*
Figure 103. A Mecopteron *Boreus.*
Figure 104. A Dipteron *Tipula* sp.
Figure 105. A Mecopteron *Nannochorista dipteroides.*
Figure 106. A mole cricket *Cylindracheta spegazzinii.**
Figure 107. A typical Mecopteron.

* Figure number missing on Plate XVI.

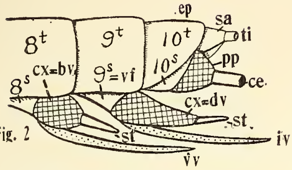


Fig. 2

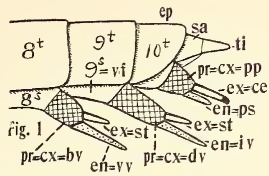


Fig. 1

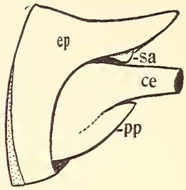


Fig. 5

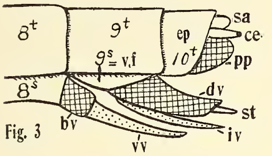


Fig. 3

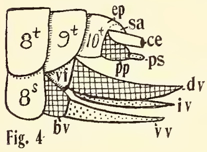


Fig. 4

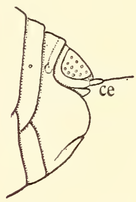


Fig. 7

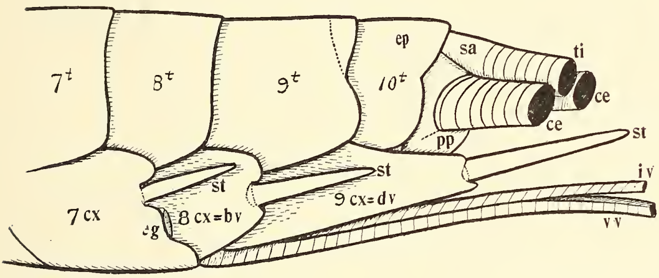


Fig. 6

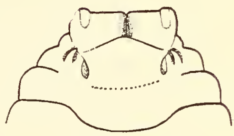


Fig. 8

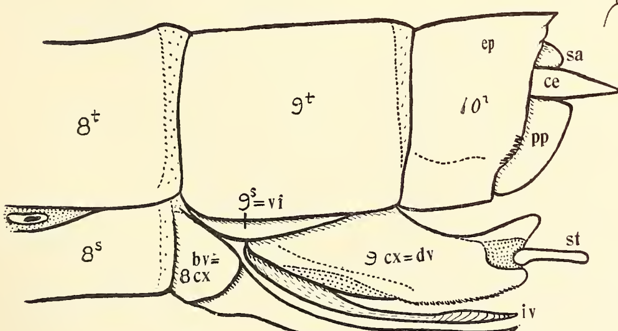


Fig. 9

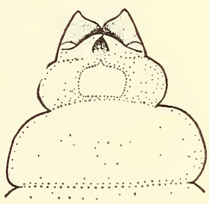


Fig. 10

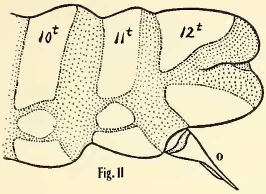


Fig. 11

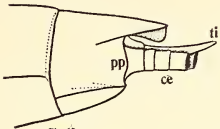


Fig. 12

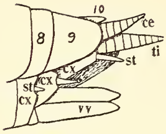


Fig. 13

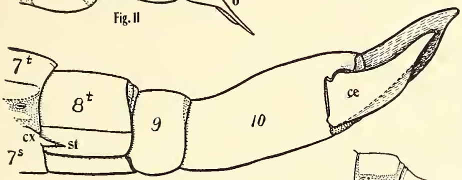


Fig. 14

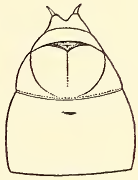
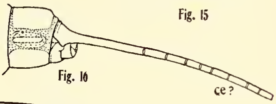


Fig. 15



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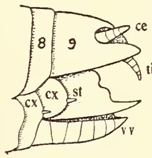

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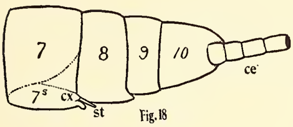

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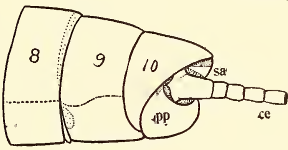

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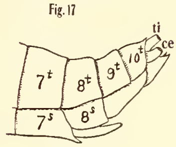

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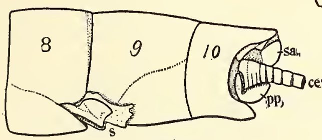

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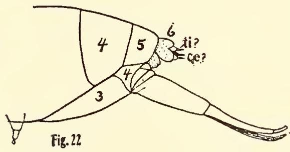

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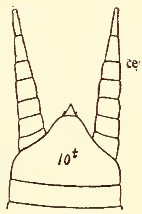

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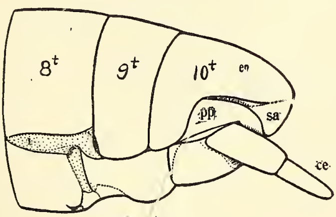

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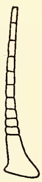
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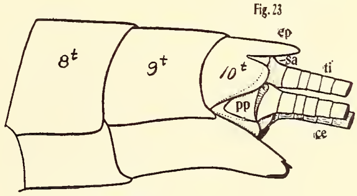

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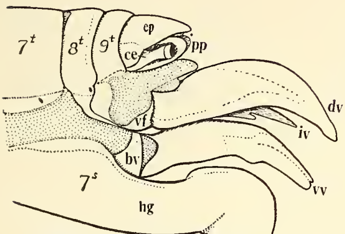

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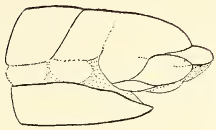
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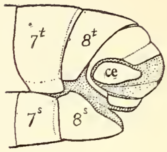

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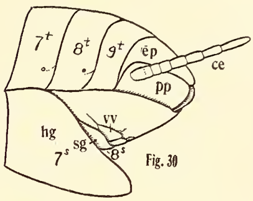

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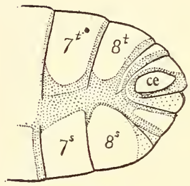

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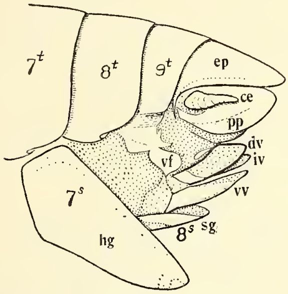

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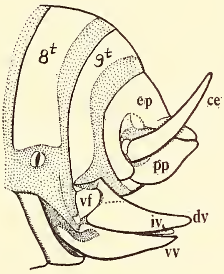

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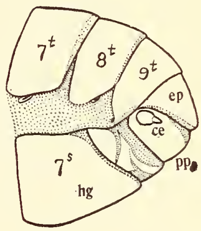

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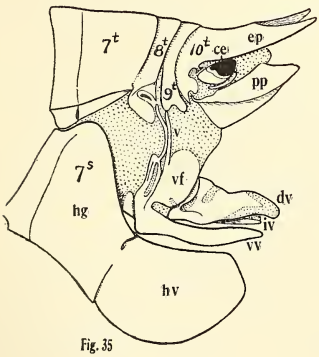

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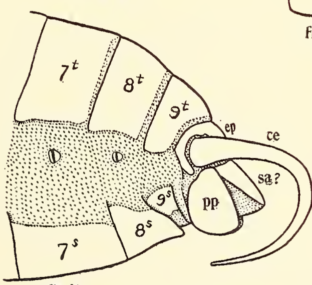

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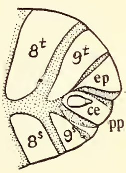

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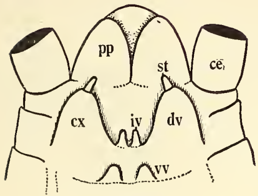

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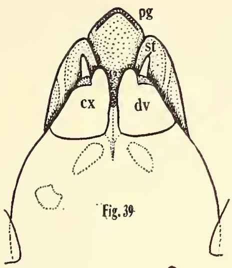

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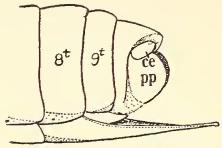

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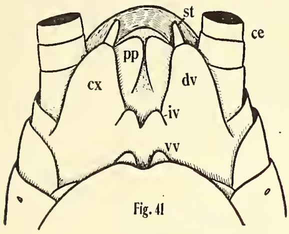

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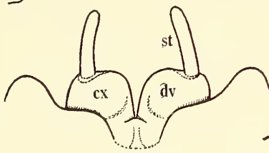

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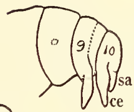

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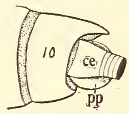

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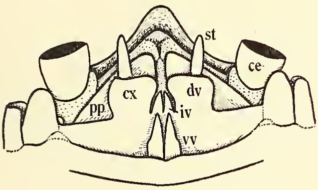

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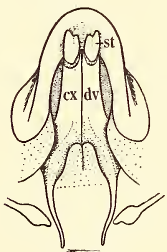

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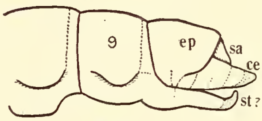

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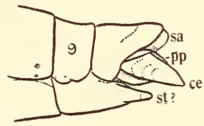

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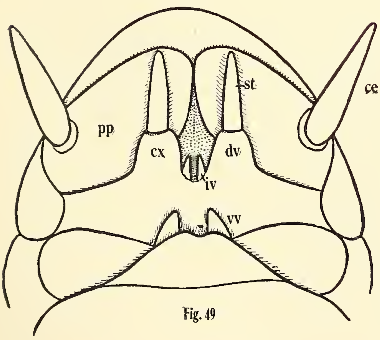

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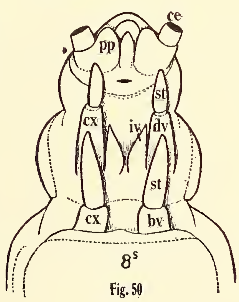

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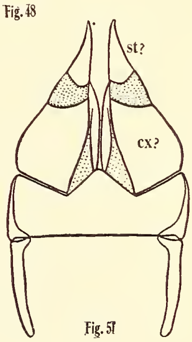

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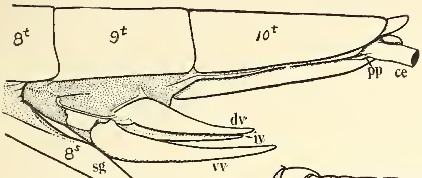

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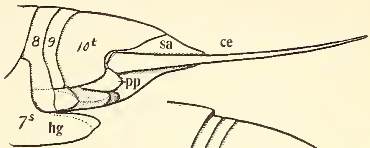
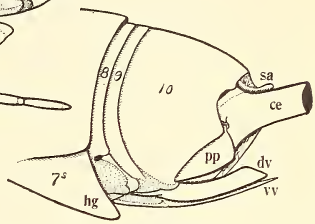


Fig. 54

Fig. 53



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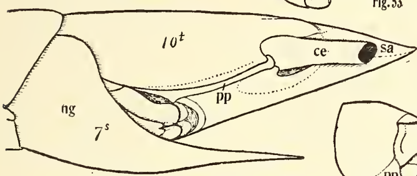

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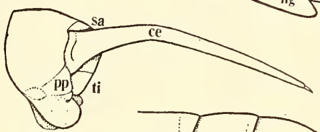

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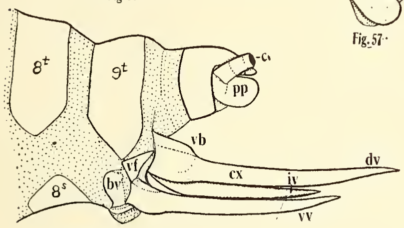

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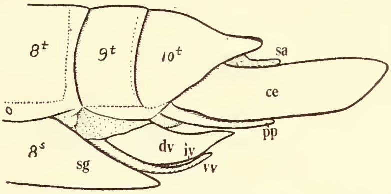

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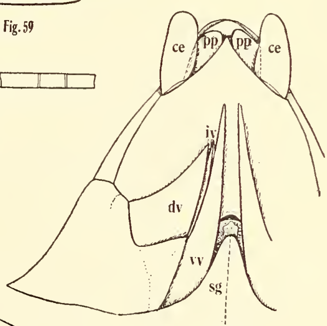

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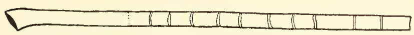
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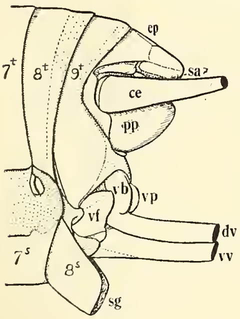

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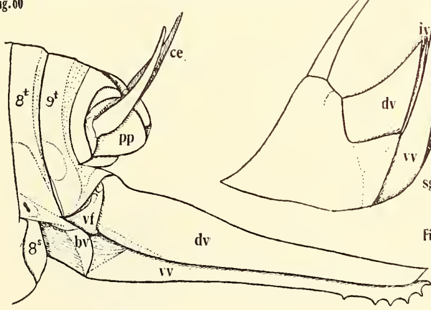

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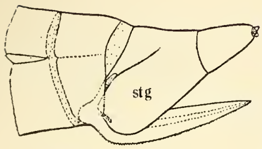

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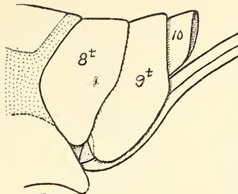

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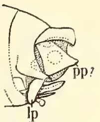

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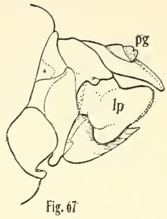

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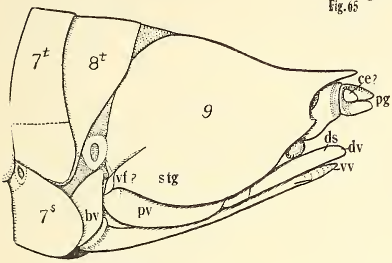

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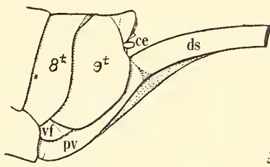

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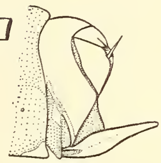
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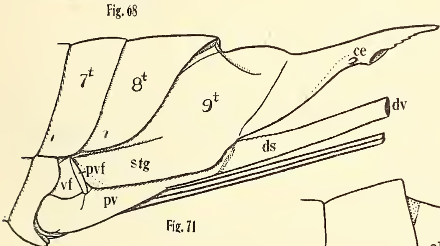

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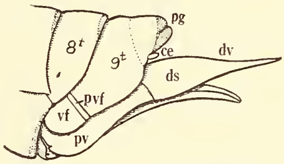

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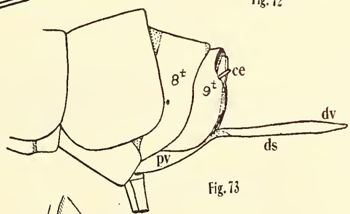

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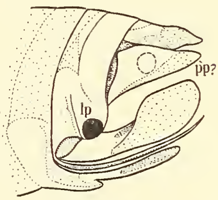

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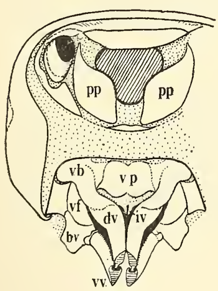

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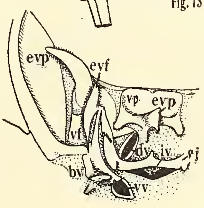

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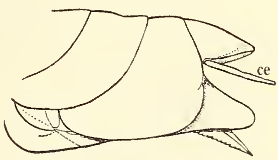

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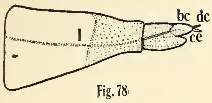

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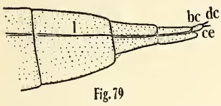

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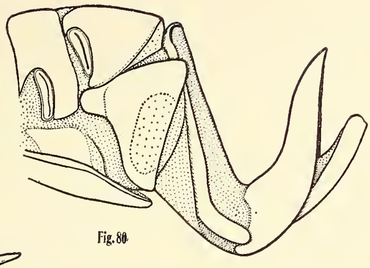
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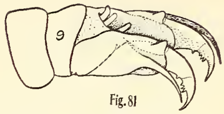

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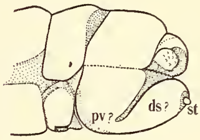

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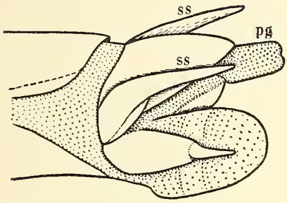

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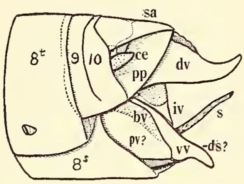

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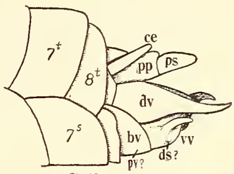

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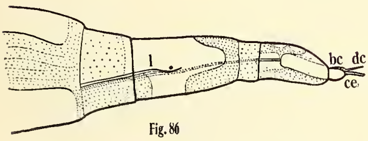

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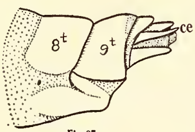

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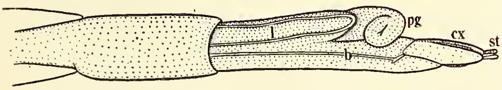

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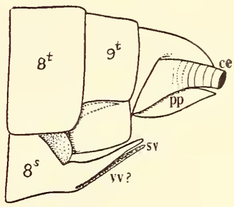

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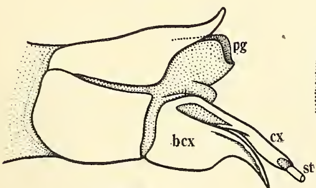


Fig. 90

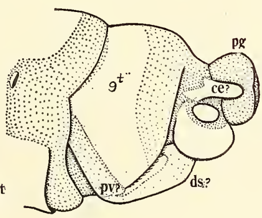


Fig. 91

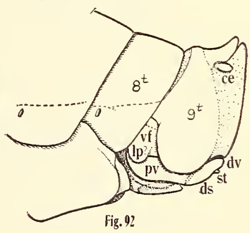


Fig. 92

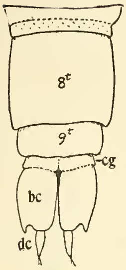


Fig. 96

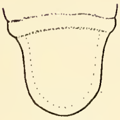


Fig. 93

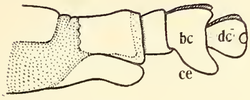
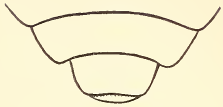


Fig. 94



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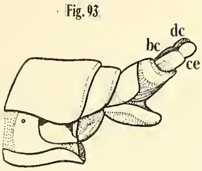

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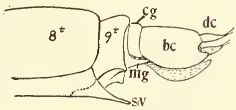


Fig. 98

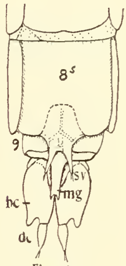


Fig. 102

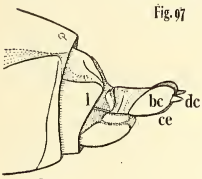


Fig. 9

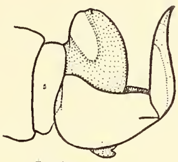


Fig. 100

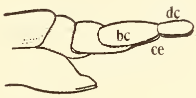


Fig. 101

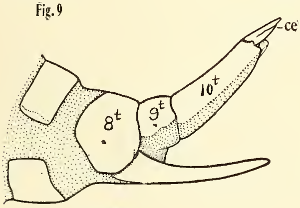


Fig. 103

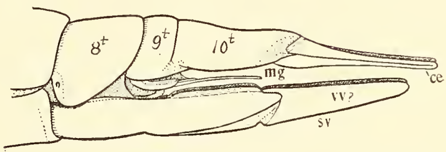
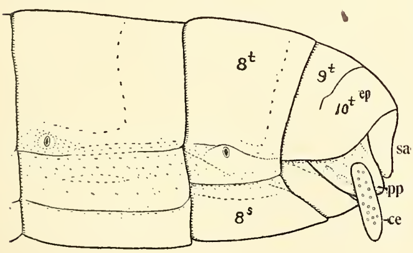


Fig. 104



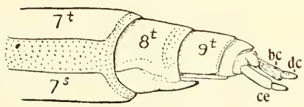


Fig. 105

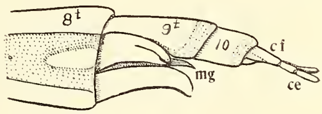


Fig. 107

INCREASING THE EFFECTIVENESS OF THE NICOTINE INSECTICIDAL UNIT CHARGE[1]

By Edward R. McGovran

Nicotine Research Fellow, Rutgers University, 1927–1928.

Introduction

Thoughtful analysis of the problem indicated in the title of this paper gave the writer reason to believe that the insecticidal efficiency of the nicotine unit could best be increased through the introduction of that substance, when carried in an aqueous solution, into the breathing system of insects against which it is normally used as a spray. Analysis of the operation of penetration led the writer to believe that a layer of the aqueous solution must be established over part or all of the breathing pores and this layer over the breathing pores must be sufficiently thin to be drawn readily through the breathing pores with ingoing currents of air. Obviously, the establishment of a layer of aqueous solution over the breathing pores involved a sufficient reduction of the normal interfacial tension existing between it and the integument of the insect to permit ready wetting of the integument. Obviously also, the production of a layer sufficiently thin to permit its inhalation required a decided reduction in the normal surface tension of the aqueous solution.

Since the factors of interfacial and surface tensions seem to underlie a solution of the problem of introducing the aqueous solution into the breathing system of insects it was decided to devote attention, first, to one and then to the other phase.

Study of Interfacial Tension Existing Between the Aqueous Solution and the Integument of Insects

Application of the term "interfacial tension" to the relation existing between the aqueous solution and the integument of an

[1] Paper of the Journal Series, New Jersey Agricultural Experiment Station, Department of Entomology.

insect may not be technically correct but it does serve to indicate in a general way the meaning the writer has in mind.

The insect selected for this test was the honeybee (*Apis mellifera*) because of its ready availability at all times. The bees were removed from the hive and anesthetized with ether. The abdomen was then removed, care being taken not to mutilate or in any way change its surface. The abdomen was then fastened with the tergal surface up and as nearly in a horizontal position as possible. A drop of the solution to be tested was placed in the center of this area. A small syringe that delivered a uniform drop about 2.04 cubic millimeters in volume was used to apply the material. Two diameters of the drop were taken at right angles to each other with an ocular micrometer in a binocular microscope. The average of these two diameters was used to compute the area of the integument that was wetted by the drop of solution. The shape of the drop, when in contact with the integument of the honeybee, was usually an irregular circle. The segmented structure of the abdomen sometimes interfered with the uniform spread of the solution in some directions.

In order that any relationship which might later appear to exist between surface tension and spread, the surface tension of the liquid used was always determined before the solution was applied to the integument of the insect. The surface tension[2] was determined by the rise of the liquid in a capillary tube. This method of determining surface tension was used through the entire study. The temperature of the liquid was determined at the time the measurement of surface tension was being made. All determinations were made at room temperature. The effect of this variation in temperature upon the results obtained was considered negligible, in view of the fact that the variation in surface tension, arising from the change in temperature, was smaller than the error allowed under controlled conditions for this method of determining surface tension.

[2] The formula $Y = \frac{r.h.s.g.}{2}$ was used in calculating the static surface tension of the liquid in dynes per centimeter. In this formula "Y" is equal to the static surface tension of the liquid in dynes per centimeter, "r" is equal to the radius of the capillary tube in centimeters, "h" is equal to height in centimeters in the tube to which the liquid rises, "s" is equal to the specific gravity of the liquid, and "g" is the value of gravity (981 dynes).

TABLE I

SUMMARY OF THE DATA ON THE SPREAD OF AQUEOUS SOLUTIONS ON THE INTEGUMENT OF THE HONEYBEE

No. of Bees Used	Material Used	Initial Area Covered by Drop[1]	Area Covered After 1 Minute	Area Covered After 5 Minutes	Area Covered After 10 Minutes	Surface Tension[2]	Temperature of Liquid[3]
5	Distilled Water	2.96	2.71	2.52	2.89	75.9	24.0° C
5	2% Sodium Oleate	3.65	14.19			28.4	27.0° C
6	1% Sodium Oleate	3.06	14.02	14.19		28.4	28.0° C
6	½% Sodium Oleate	3.00	8.78	14.19		27.4	26.0° C
5	2% Fish Oil Soap	1.89	6.38	11.90	14.19	31.6	26.0° C
5	1% Fish Oil Soap	1.55	4.59	6.93	10.62	30.5	25.5° C
5	½% Fish Oil Soap	2.38	4.53	7.65	9.33	30.5	26.0° C
5	Distilled Water saturated with nonylic acid	2.13	2.45	2.52	2.59	38.0	27.0° C

[1] Areas are given in square millimeters.
[2] Surface tension in dynes per centimeter.
[3] Temperature in degrees Centigrade.

The carrying liquid in all cases was distilled water. Many materials were tried but of them all, various soaps and nonylic acid gave some promise. The fish oil soap was a commercial brand with a content of about 63 per cent. water. Sodium oleate was a supposedly pure product, as nearly free from water (about 10 per cent. water) as could be obtained. The results of this study are set forth in table I.

The data in this table are graphically set forth in figure 1. The figures in the table and the lines in the figure show at once that the speed of coverage with all soap treated solutions is more rapid than with distilled water alone, that the sodium oleate solutions was greater than with the fish oil soap solutions. To make this conclusion yet more definite the relation between the fish oil soap and the oleic acid soap should be made still more clear. The sodium oleate carried about 10 per cent. water while the fish oil soap carried about 63 per cent. water. The sodium oleate soap was, therefore, 2.4 times as rich in soap as the fish oil soap. The 0.5 per cent. fish oil soap solution was actually 0.185 per cent. soap, the 1 per cent. fish oil soap solution was actually 0.37 per cent. soap, and the 2 per cent. was actually 0.74 per cent. The 2 per cent. fish oil soap should, therefore, be compared with the 1 per cent. sodium oleate solution and should, if it were an effective agent in promoting spread, fall between the curves representing 1 per cent. sodium oleate solution and 0.5 per cent. sodium oleate solution but as a matter of fact it falls much below the latter, indicating that sodium oleate, soap unit for soap unit, has greater power in expediting spread under the above conditions than has fish oil soap.

A curious and somewhat confusing result is found when the spread of distilled water is compared with the spread obtained with the nonylic acid treated distilled water. The speed of spread of nonylic acid treated distilled water was no greater and perhaps even a little less than the spread of distilled water alone, yet the surface tension was 38.0 dynes as compared with 75.9 dynes. This seems to prove that there exists no complete relation between static surface tension of the aqueous solution and its ability to spread over the insect integument. Furthermore, maximum reduction in surface tension was obtained in each kind

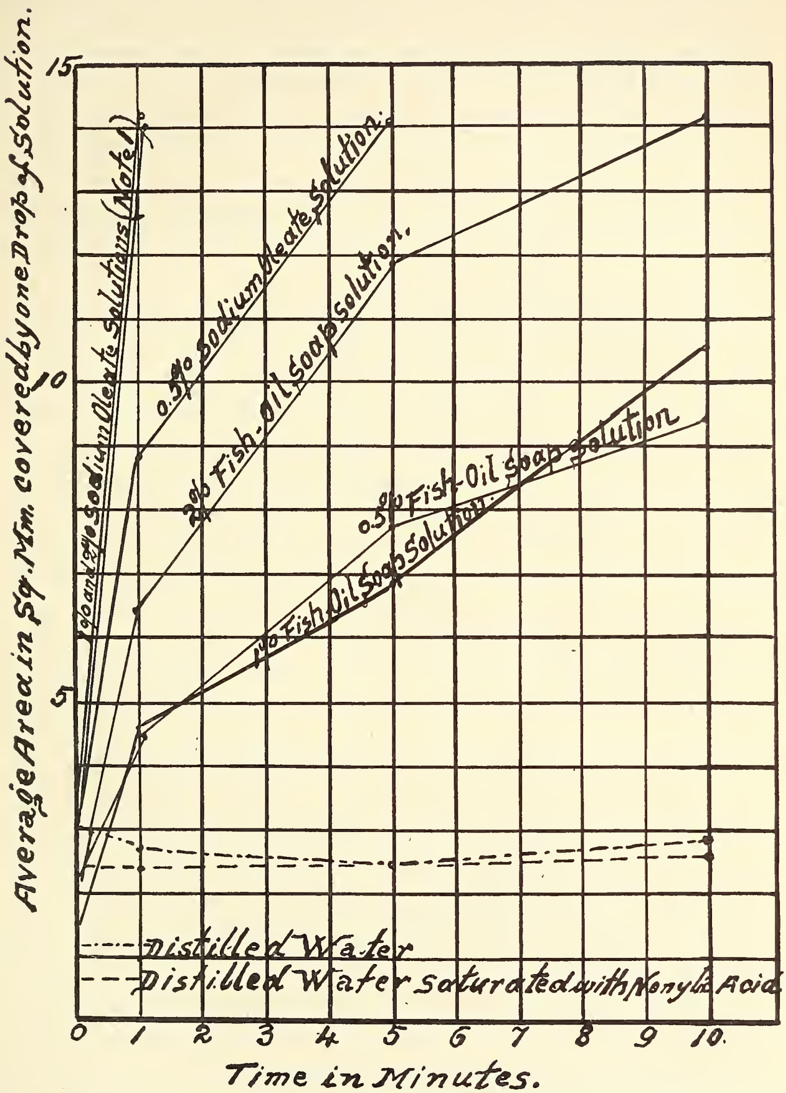


Figure 1. The spread of aqueous solutions on the abdominal integument of the honeybee.

of soap when as much as 0.5 per cent. was used, yet the speed of coverage was materially increased when twice as high a per cent. of the particular soap was employed. This seems likewise to support the idea that there does not exist a complete relationship between static surface tension and rate of spread of the aqueous solution over the insect's integument. When we recall the more or less known fact that the insect's integument is apt to be covered with wax and wax-like substances and that the interfacial tension between oils and water (1 and 4) is materially reduced by the addition of soap to the water, it seems at once reasonable that larger amounts of soap should give better wetting and consequently more rapid spread. Doubtless this effect of increased amounts of soap will vary with different kinds of insects because of the different types and amounts of wax and wax-like materials occurring on the integument.

Thus it seems; (1) that the addition of soap to distilled water increases the speed at which the treated aqueous solution can cover the integument of certain insects; (2) that within limits the greater the amount of soap the more rapidly does the coverage occur; (3) that this relationship holds even after the maximum degree in reduction of surface tension of the aqueous solution has taken place; (4) that surface tension, therefore, has no completely correlative relationship to interfacial tension.

STUDY OF SURFACE TENSION OF AQUEOUS SOLUTIONS

In table I of the preceding section of this paper it has been noted that the ordinary surface tension of water is about 76 dynes and that by the addition of about 0.5 per cent. sodium oleate this surface tension may be cut as low as 27.5 dynes. When we recognize that kerosene, which has a surface tension of about 28.5 dynes, has been shown by Nelson (9) and others to enter the breathing system of certain insects it seems entirely probable that an aqueous solution, with a surface tension of 27.5 dynes, would be able to do likewise, especially if the interfacial tension of this solution had been so reduced that the insect's integument could be readily and quickly filmed.

In the previous section it has been shown that an aqueous solution treated with sodium oleate can and does wet and spread

with great rapidity and in this section it has been pointed out that the surface tension of this sodium oleate treated aqueous solution is lower than kerosene. It seemed, therefore, entirely probable that the aqueous solution treated with sodium oleate would enter the breathing system when sprayed upon the insect in the usual fashion.

Penetration of the Breathing System by Aqueous Solutions of Various Surface Tensions and Various Interfacial Tensions

To determine actual penetration it was, of course, necessary to utilize a dye. Anilin blue was selected as the dye because its solubility in water was sufficient to give to the aqueous solution a pronounced blue color.

The honeybee was again employed as the insect because of its availability and because of the large size of its propodial spiracle. The bees were removed from the hive and fed sugar and water. They were then placed in a clamp that held them in position so that the propodial spiracle could be observed with a binocular microscope. The propodial spiracle of the honeybee is 0.23 millimeters along the greatest diameter and 0.06 millimeters along the shortest diameter. It is oval in shape and bears a ridge along its anterior margin (12). The membranous valve is plainly visible and its movements can be detected with a microscope. The pubescence on the thorax of the honeybee is so dense around the spiracles that it was necessary to remove it in order to see the valve of the spiracle clearly. The movements of the spiracular valves varied. In some specimens the valve would only flutter slightly, as though air were rushing by it, and never open wide. In others it would open only slightly at the upper and lower corners, closing immediately. In still others the valve would be drawn completely to one side, leaving the spiracle wide open for as long as a second in extreme cases. These movements occurred in almost all possible combinations and rate of change from one type of movement to another. The spiracular valve in some specimens examined could not be observed to move even when watched continuously for three or four minutes. Possibly, confining the bees in the small wood and wire clamps,

which were used, interfered with the respiration of some specimens more than others, for the variation between the movements of the valve of the spiracle of different specimens was very striking.

A small drop of solution was placed directly over the spiracle and the movements of the liquid and the valve of the spiracle were observed. The legs and wings of the bee were held so that they did not interfere with the liquid covering the spiracular opening. As there was a possibility of the bees being mechanically injured when they were put into or removed from the clamp, no record was kept as to the length of time they lived after they were released. Eight lots of ten bees each were treated as described in table II.

TABLE II

THE ENTRANCE OF LIQUIDS INTO THE BODY OF THE HONEYBEE THROUGH THE SPIRACLES

Lot No.	Material Applied to the Insect	Surface Tension of the Liquid*	Entrance of the Liquid Through the Spiracle
1.	Distilled water	76.0	None
2.	0.03% free nicotine in distilled water	78.0	None
3.	0.05% free nicotine in distilled water	78.0	None
4.	0.1% free nicotine in distilled water	73.8	None
5.	0.2% free nicotine in distilled water	70.2	None
6.	1.0% free nicotine in distilled water	68.5	None
7.	1.0% sodium oleate in distilled water[A]	28.5	Slow
8.	Water white kerosene[B]	28.5	Rapid

* Surface tension is given in dynes per centimeter.

[A] and [B]. Both these materials show great rapidity of spread over the insect's integument and presumably have low interfacial tension with the integument.

Solution used in lots 1 to 6, inclusive, in Table II, consisting of distilled water, and of distilled water containing various strengths of free nicotine derived from "Black Leaf 50," remained in hemispherical drops covering the spiracle. The area covered by these solutions increased in size very slowly and diminished as soon as appreciable amounts of water had evapor-

ated. The spiracular valve continued to open and close under the drop but no material could be observed entering, even when the valve was wide open. In lots 7 and 8, the liquids, consisting of 1 per cent. sodium oleate in lot 7 and water white kerosene in lot 8, spread out in a thin layer over the integument of the insect, the soap solution spreading slower than the oil. When the spiracular valve opened only slightly, the kerosene could be seen flowing rapidly in through the spiracle. The soap solution flowed in only slowly when the valve was open. The bees, treated with a 1 per cent. solution of free nicotine (lot 6) and those treated with kerosene (lot 8), were killed before the integument dried but the spiracular valve did not close. The valve action usually became very rapid and violent just before the insect died.

Lee (5) found the thoracic spiracle on the grasshopper to function as intake openings for respiration. If it can be assumed that the respiratory movements in the honeybee, as observed by Snodgrass (12), indicate that the same respiratory circulation occurs in the honeybee as in the grasshopper, it is possible that the material was drawn into the trachea by the reduced pressure within. The high surface tension of the distilled water and the nicotine solution (lots 1 to 6, inclusive) formed a surface layer that was strong enough to withstand the suction and the force of gravity acting upon it and none of the material could break through this surface "skin" and enter the trachea. In lot 7, 1 per cent. oleate was used and in lot 8 water white kerosene was employed. The layer of liquid formed over the opening of the spiracle was so weak that, when acted upon by the respiratory suction and pull of gravity it readily extended, allowing the liquid to flow into the trachea.

Thus it seems that, when the aqueous solution has its interfacial tension sufficiently reduced to permit rapid coverage of the insect's integument to occur and surface tension sufficiently reduced to permit this coverage to occur in a thin layer it is able to penetrate the spiracle and to enter the trachea connected therewith.

For the purpose of securing further proof of this penetration of spiracles by aqueous solutions, it was decided to treat honey-

bees while alive with an aqueous solution, the surface and interfacial tension of which had been similarly reduced, and which had been charged with anilin blue.

Honeybees were removed from the hive and placed in small wire screen cages, five in each. These cages were paraffined to insure their not being toxic to the bees. Previous experiments carried out by Nelson (9) had proved that unparaffined screen cages were very toxic to honeybees. The bees were then sprayed with six cubic centimeters of spray solution. The spray was carefully applied with a hand atomizer so that each of the bees in the cage was completely covered. The spray was allowed to remain on the bees for a given length of time. The bees were then rinsed with distilled water to remove the stain from their external surfaces. This was a precaution to minimize the possibility of spray on the integument of the insect entering the tracheæ during dissection.

In preliminary trials it was found that by pulling off the head and prothorax of the honeybee two large tracheæ were exposed. These tracheæ open through the first thoracic spiracle, which is irregularly oval in shape and about 0.14 millimeters in length along its greatest diameter. This spiracle can not be firmly closed, but is protected by opening into a deep pocket which is covered by a flap-like covering of the pocket it opens into. (12.)

This method of dissection exposed the tracheæ rapidly and uniformly and minimized the amount of distortion. It rendered about 1.5 millimeters of the tracheæ visible.

As soon as the rinsing was completed the bees were partially dried as rapidly as possible by shaking the cage and then fanning it. They were dissected immediately and the results recorded. In this manner penetration into the tracheæ or spreading along the tracheal wall after the insect had died was largely prevented. Muscular reflexes occurred in most of the bees during and after dissection. Before dissection a drop of free nicotine was placed on the proboscis of any specimens that were too active to allow rapid observation of the tracheæ after dissection. The results of these tests are set forth in Table III.

TABLE III

THE PENETRATION OF AQUEOUS SOLUTIONS INTO THE THORACIC TRACHEÆ OF THE HONEYBEE

Lot No.	Material Used	No. of Bees Examined	Length of Time the Spray was Left on the Bees	Amount of Penetration into the Tracheae (Note 1)	Surface Tension of Liquid in Dynes in Cm.	Temperature of Liquid
1	2% Nicotine oleate and anilin blue	2	1 minute	Medium	29.0	22.5° C
	"	1	1 "	Slight	29.0	22.5° C
	"	2	1 "	None	29.0	22.5° C
	"	3	12 "	Heavy	29.0	22.5° C
	"	2	12 "	Medium	29.0	22.5° C
2	1% Nicotine oleate and anilin blue	5	1 "	None	29.5	21.5° C
	"	5	15 "	Heavy	29.5	21.5° C
	"	1	15 "	None	29.5	21.5° C
3	0.5% Nicotine oleate and anilin blue	2	15 "	Medium	28.5	20.5° C
	"	1	15 "	Slight	28.5	20.5° C
	"	2	15 "	None	28.5	20.5° C
4	0.25% Nicotine oleate and anilin blue	5	20 "	None	30.6	22.5° C
5	0.1% Nicotine oleate and anilin blue	5	20 "	None	32.7	22.5° C
6	0.05% Nicotine oleate & 0.25% para-cresol & anilin blue	5	15 "	None	33.7	22.0° C
7	0.25% Nicotine oleate & 0.5% para-cresol & anilin blue	3	15 "	Slight	30.8	22.0° C
	"	2	15 "	None	30.8	22.0° C

TABLE III—(*Continued*)

THE PENETRATION OF AQUEOUS SOLUTIONS INTO THE THORACIC TRACHEÆ OF THE HONEYBEE

Lot No.	Material Used	No. of Bees Examined	Length of Time the Spray was Left on the Bees	Amount of Penetration into the Tracheae (Note 1)	Surface Tension of Liquid in Dynes in Cm.	Temperature of Liquid
8	1.0% pinene emulsion, 0.25% nicotine oleate with anilin blue and orange red	5	15 minutes	None		
9	0.5% pinene emulsion, 0.25% nicotine oleate with anilin blue and orange red	5	15 "	None		
10	1.0% para-cresol and anilin blue	6	15 "	None	44.3	25.0° C
11	1.0% sodium hydroxide + cresol and anilin blue	3	15 "	None		
12	Concentrated sodium hydroxide + cresol + anilin blue	3	15 "	Medium	38.0	22.0° C
13	25.0% ethyl alcohol 0.5% cresol & anilin blue	4	15 "	None	38.0	26.5° C
14	Water saturated with nonylic acid & 0.1% free nicotine & anilin blue	10	15 "	None	61.3	25.0° C
15	0.5% meta-cresol and anilin blue	5	20 "	None	59.1	24.5° C
16	0.5% meta-cresol + nonylic acid + anilin blue	3	20 "	None	33.7	27.0° C

TABLE III—(*Continued*)

THE PENETRATION OF AQUEOUS SOLUTIONS INTO THE THORACIC TRACHEÆ OF THE HONEYBEE

Lot No.	Material Used	No. of Bees Examined	Length of Time the Spray was Left on the Bees	Amount of Penetration into the Tracheae (Note 1)	Surface Tension of Liquid in Dynes in Cm.	Temperature of Liquid
17	1% meta cresol + nonylic acid + 0.1% nicotine sulphate and anilin blue	5	15 minutes	None	38.0	22.0° C
18	0.5% para-cresol, water saturated with nonylic acid & 0.01% nicotine sulphate + anilin blue	5	15 "	None	34.0	25.0° C
19	1.0% carbolic acid water saturated with nonylic acid + 0.1% nicotine sulphate + anilin blue	3	15 "	None	30.6	24.0° C

Note 1

SLIGHT (penetration)—The dye appearing only near the integument close to the first thoracic spiracle.

MEDIUM (penetration)—The dye appearing in the full length that was visible of one large tracheæ or part way in both.

HEAVY (penetration)—Both main tracheæ stained throughout the entire length visible and possibly some stain in the smaller branches.

None (no penetration)—No dye appearing in the thracheæ of the insect.

This table indicates that only slight entrance can be obtained from a spray possessing a surface tension of over 38 dynes per centimeter. Appreciable penetration was brought about at this surface tension, however, when a concentrated solution of NaOH was used. In this case the sodium hydroxide probably reduced the interfacial tension possibly by saponification of some of the wax-like substances upon the integument of the honeybee.

Thus in this series of tests there appears clear and distinct proof that when both surface and interfacial tensions of the aqueous solutions are reduced to the proper point, actual penetration of the breathing system occurs.

The Effect of Using Aqueous Solutions, Conditioned as to Surface and Interfacial Tensions as Set Forth in the Preceding Parts of this Paper, Upon Certain Plant Lice When Used Either with or Without Nicotine

Sodium oleate, having proven to be an efficient material for enabling aqueous solutions to penetrate the breathing system of the honeybee, and fish oil soap having been a widely used material for treatment of plant lice, the work of conditioning the aqueous solution for surface tension and interfacial tension was limited to these two agents. Distilled water was utilized as a check throughout. The number of individual plant lice used in each test was large in order to reduce, as far as possible, the effect of individual variations. These studies covered a period in which the variation of temperature did not much exceed 10° F., while atmospheric moisture was more or less variable. In view of the fact that atmospheric moisture has by past indications been shown to have little effect on the metabolism of plant lice it was not considered necessary to control this factor. All experiments were conducted in the laboratory at New Brunswick, New Jersey, and in no case were the insects subjected to direct sunlight. The temperatures were, therefore, temperatures of shade. The amount of material applied to the plant lice in all experimentts was that which was necessary to wet the bodies of the lice. The spray was applied with an atomizer. The average kill obtained with distilled water on the green apple aphis was 9.24 per cent.

The results of treatments of the cabbage aphis and green apple aphis with aqueous solutions of soap are set forth in Table IV. All soap figures are now based upon actual soap.

TABLE IV

STUDY OF THE RELATION OF AQUEOUS SOLUTION OF SOAP TO THE KILL OF APHIS

(Each determination involved from one hundred to several hundred aphids.)

	Per cent.	
Av. kill (Cabbage aphis) F. O. S.	1/16	7.4
	1/8	10.9
	1/4	15.0
	1/2	69.7
Av. kill (Cabbage aphis) S. O.	1/16	12.2
	1/8	10.3
	1/4	26.6
	1/2	94.7
Av. kill (Green apple aphis) F. O. S.	1/3	20.7
Av. kill (Green apple aphis) S. O.	1/6	28.9
	1/3	38.1
	1/2	96.0
	2/3	95.6
	1	91.8

Note:—F. O. S. = Fish oil soap.
S. O. = Sodium oleate soap.

This table seems to show that sodium oleate soap is more effective than fish oil soap and that approximately 0.5 per cent. is the most efficient dosage.

The next question was the effect of free nicotine as compared with nicotine sulfate. The amount of soap used was reduced in order that the kill might in all cases stay below 100 per cent. The work was done upon the cabbage aphis. The same methods of application were employed as set forth above. The results appear in table V.

This table indicates that free nicotine is more powerful than nicotine sulfate when used with the same strength of soap.

TABLE V

STUDY OF THE RELATION OF SOAP AND NICOTINE TYPES TO KILL CABBAGE APHIS

(Each determination involved from one hundred to several hundred aphids.)

	Average Per Cent. Kill
F. O. S. 1/6 Per cent. + N. S. (1 to 5000)	71.3
F. O. S. 1/6 Per cent. + S. F. (1 to 5000)	89.2
S. O. 1/6 Per cent. + N.S. (1 to 5000)	82.1
S. O. 1/6 Per cent. + F. N. (1 to 5000)	87.2

Note:—F. O. S. = Fish oil soap.
S. O. = Sodium oleate.
N. S. = Nicotine Sulfate.
F. N. = Free nicotine.

TABLE VI

STUDY OF RELATION OF VARIOUS STRENGTHS OF SOAP AND NICOTINE TO THE KILL OF GREEN APPLE APHIS AND CABBAGE APHIS

(Each determination involved from one hundred to several hundred aphids.)

On Green apple aphis	Per cent.
S. O. 1/6 Per cent. + F. N. (1 to 50,000)	71.5
S. O. 1/6 Per cent. + F. N. (1 to 25,000)	90.4
S. O. 1/3 Per cent. + F. N. (1 to 20,000)	83.4
S. O. 1/3 Per cent. + F. N. (1 to 17,500)	65.3
S. O. 1/3 Per cent. + F. N. (1 to 15,000)	84.7
S. O. 1/3 Per cent. + F. N. (1 to 12,500)	83.1
S. O. 1/3 Per cent. + F. N. (1 to 10,000)	91.7
S. O. 1/2 Per cent. + F. N. (1 to 50,000)	99.5
S. O. 1/2 Per cent. + F. N. (1 to 25,000)	87.6
S. O. 1 Per cent. + F. N. (1 to 25,000)	94.5
On Cabbage aphis	
S. O. 1/6 Per cent. + F. N. (1 to 20,000)	60.0
S. O. 1/6 Per cent. + F. N. (1 to 10,000)	78.2
S. O. 1/6 Per cent. + F. N. (1 to 7,500)	89.5
S. O. 1/6 Per cent. + F. N. (1 to 6,250)	90.3
S. O. 1/6 Per cent. + F. N. (1 to 5,000)	87.2

Note:—S. O. = Sodium oleate.
F. N. = Free nicotine.

The next problem attacked was that of nicotine dosage. In this study sodium oleate was the only soap used. The methods of application were the same as previously outlined and the percentage of soap represents actual soap. The results are set forth in table VI.

This table shows clearly that when 0.5 per cent. of sodium oleate soap is used very high dilutions of nicotine can be employed with lethal results to the plant lice treated. This points to the practical application of this study, namely, that when sodium oleate, which is cheap, is used at a strength as great as 0.5 per cent. the amount of nicotine necessary to effect lethal results on plant lice under summer temperatures is very small. It should be pointed out that this work upon aphids was done during hot weather in the latter part of the summer when the insect resistance was low and that this fact largely accounts for erratic results. Nevertheless, the general trend of the results is clear. Work done by Mr. Filmer in the spring of 1929, which will be published later, shows that the above trend can be utilized with striking results in practical orchard procedure against apple plant lice.

Summary and Conclusions

1. Distilled water or distilled water carrying nicotine extract, having a surface tension of 40 or more dynes per centimeter, did not penetrate into the tracheæ of the honeybee even though the the integument was wetted thoroughly.

2. A reduction of the interfacial tension existing between the aqueous solutions and the integument and of surface tension sufficient to permit rapid coverage of the integument with a thin layer enables the aqueous solution to penetrate the breathing system of the honeybee.

3. Incorporation of sodium oleate soap in amounts varying from 0.2 per cent. to 2.0 per cent. (actual soap) so reduced the interfacial tension and the surface tension of the aqueous solutions as to permit this phenomenon to occur.

4. Sodium oleate soap, soap unit for soap unit, is more efficient in accomplishing these reductions of interfacial and surface tensions than fish oil soap and either is more efficient for this purpose than any other substances with which the writer worked.

5. Free nicotine is a more efficient agent against certain plant lice for use with the above conditioned aqueous solution than nicotine sulfate.

6. The size of the lethal charge of nicotine for destruction of certain plant lice is very greatly reduced when it is incorporated in an aqueous solution, the interfacial and surface tensions of which have been reduced as set forth above.

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Generic names begin with capital letters. New genera, subgenera, species, subspecies, varieties and new names are printed in italics.

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